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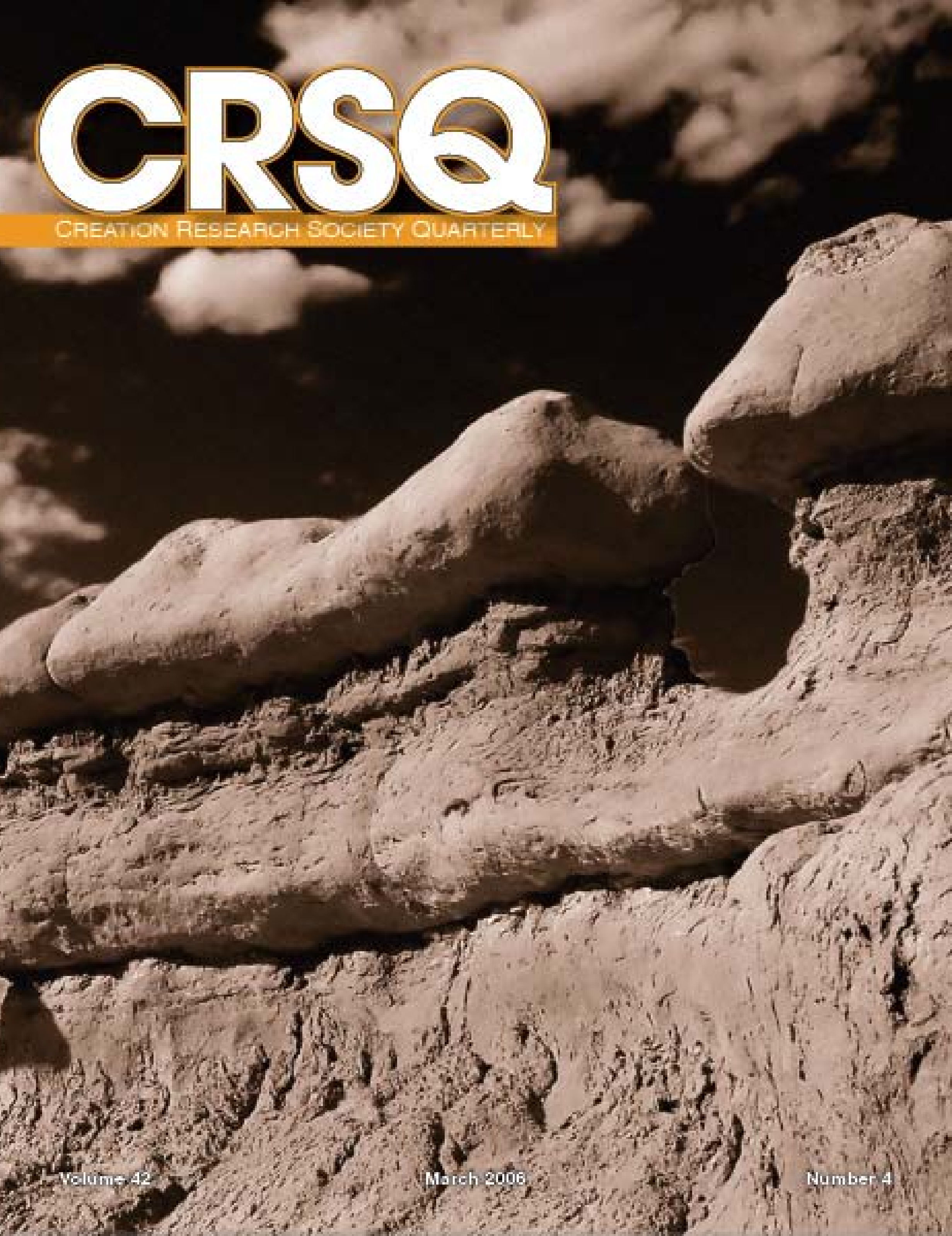
## Creation Research Society Quarterly



Volume 42 March 2006 Number 4

# Creation Research Society Quarterly

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**Haec Credimus**

*For in six days the Lord made heaven and earth, the sea, and all that in them is, and rested on the seventh.—Exodus 20:11*

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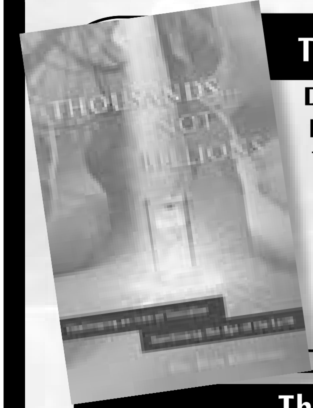

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This non-technical book is the laymen's guide to the *Radioisotopes and the Age of the Earth* (RATE) project. It has been written to equip the layperson to defend scientific six-day creation and refute modern dating techniques.

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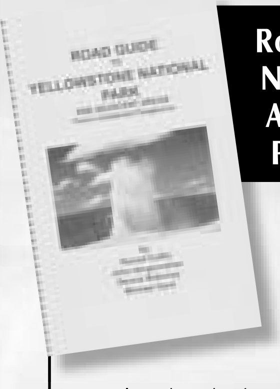
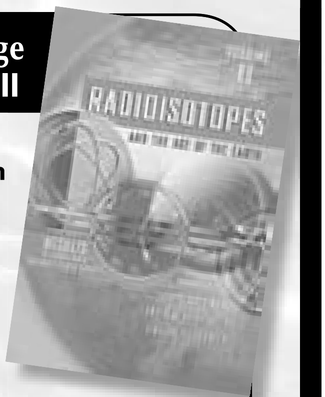


## Road Guide to Yellowstone National Park and Adjacent Areas From a Creationist Perspective

**Harold Coffin, John Hergenrather, Dennis Bokovoy, and Michael Oard. 2005. Creation Research Society, 101 pages. $12.00.**
This is the second in a series of geological road guides for National Parks, National Monuments, and other significant geological regions frequented by a large number of tourists. The guide is a mile-by-mile log of significant geological sites, along with biological and historical tidbits, all from a creationist perspective. In addition to the major roads in the Park, the road guide includes the Beartooth Highway between Red Lodge and Cooke City, Montana, northeast of Yellowstone Park—one of the most spectacular drives in the United States. The guide contains numerous color pictures and diagrams of Yellowstone Park in beautiful half-page size, with a spiral binding.



## Radioisotopes and the Age of the Earth, Volume II

**Larry Vardiman, Andrew Snelling, and Eugene Chaffin (editors). 2005. Institute for Creation Research and Creation Research Society, approximately 876 pages. $80.00 (hard cover).**
The age of the earth is an important issue in Christianity today. If the six-day Genesis account is fallacious, then how can the rest of Scripture be relied upon? *Radioisotopes and the Age of the Earth: Results of a Young-Earth Creationist Research Initiative* addresses the issues raised by the first RATE technical book in 2000. The RATE team dared to ask tough questions and has discovered that radioactive dating methods and their results are not thorough, consistent, or reliable. One of the "pillars" of old-earth evolution really supports the Scriptural account of "in the beginning."

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# Body Mass Estimates and Encephalization Quotients: A Fresh Look at the Australopithecines and *Homo habilis*

**Patrick H. Young***

## Abstract

**The australopithecines and *Homo habilis* have been publicized for years as examples of evolutionary transitional forms that launched our own human lineage. Dogmatic evolutionists have rationalized these claims on the basis of brain expansion, encephalization quotients, and bipedalism. However, any evolutionary justification for brain expansion in these extinct creatures must rest in a precise model for the determination of body mass. To insure an accurate body mass model, one must take into account whether the animal is quadruped, facultative biped, or obligatory biped. Past body mass estimates for the australopithecines and *Homo habilis* were based on assumptions about their bipedalism that have proven to be erroneous. When a body mass model is used accounting for the facultative bipedalism of the australopithecines and *Homo habilis*, the data shows that they are not highly encephalized, and hence nothing more than a microevolutionary adaptation of the pan-troglodytes.**

## Introduction

One of the classic examples of alleged evidence for human origins that evolutionists have proposed to promulgate the evolutionary transitional status of the australopithecines and *Homo habilis* is a comparison of increasing cranial capacity versus their perceived evolutionary timescale (Falk, 1980; 1987; 1998; Kirkwood, 1997; Lee and Wolpoff, 2003; McHenry, 1994a). In this context, various fossilized crania are plotted against time as an attempt to demonstrate a gradual increase in brain volume from the time of our perceived most recent common ancestor to the large-brained humans we observe today (Figure 1). The goal of this type of demonstration is to provide visual evidence (however weak) that some evolutionary advancement in intelligence over time has occurred.

Realistically, the scientific validity of using cranial capacity alone as a justification for brain expansion through any perceived evolutionary timescale is suspect at best, because there is no correction for body size (McHenry and Coffing, 2000; Kappelman, 1996; Holloway, 1988; Conroy et al., 1990). It is also in significant dispute as to whether the relative brain size of the australopithecines actually did increase over perceived evolutionary time (Falk, 1987; 1998; Martin, 1990). However, the majority view in evolutionary thinking appears to indicate that the australopithecines did possess a larger relative brain size than the apes (Pilbeam and Gould, 1974). Moreover, assuming it is a valid taxon (Brace, 1979; Wood and Collard, 1999), *Homo habilis* is believed to be the first creature to demonstrate a measurable increase in relative brain size (Falk, 1987; Lovejoy, 1981; Hawks et al., 2000; Pilbeam and Gould, 1974; Haeusler and McHenry, 2004; Ruff et al., 1997).

While a larger brain is not necessarily a predictor of higher intelligence (Beals et al., 1984; McLeod, 1983),

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* Patrick H. Young, Ph.D., P.O. Box 27001,
Richmond, Virginia 23234,
www.creationists.org/patrickyoung.html
pyoung@creationists.org

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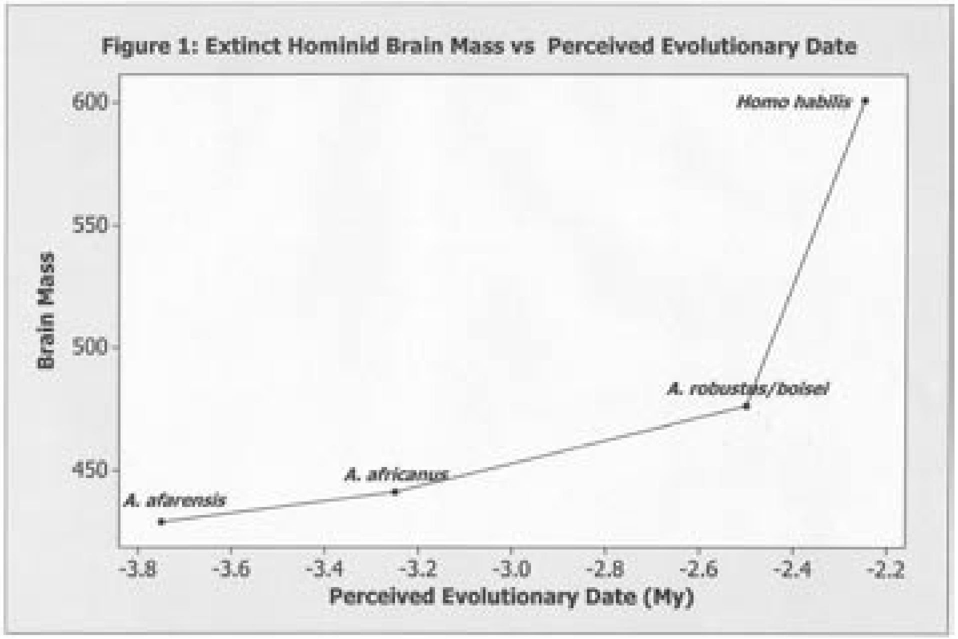

**Figure 1. Extinct hominid brain mass versus perceived evolutionary date.**

brain size is known to have a strong positive correlation with body size (Jerison, 1970). In other words, a larger body size usually requires more neurons and thus a correspondingly larger brain to handle the increase in total structural mass. However, neither suggests any true evolutionary adaptation (Pilbeam and Gould, 1974; Jerison, 1976), nor evolution to a higher taxonomic group (Cheek, 1981; Custance, 1968; Hummer, 1977; 1978; Cuozzo, 1977). Also, Jerison (1976) noted:

> …large brains do not, in general, confer an evolutionary advantage over smaller brains. Instead large and small brains represent different but equally good evolutionary outcomes (p. 90).

Currently, plots using cranial capacity alone as perceived evidence for some evolutionary advancement have fallen out of favor (Duffett, 1983). Instead, evolutionists seem to have converged on the concept of encephalization which was originally proposed by Dubois (1897). The Dubois allometric factor is based on an impromptu association of brain size to body size/body function which results in a somewhat predictable logarithmic relationship (Jerison, 1970). Dubois' initial work on encephalization has been significantly refined over the years with the extensive experimental research on primate brain size by Jerison (1970) and Martin (1990). The result of their work was the proposal of an encephalization quotient which is defined as the ratio of the true mass of a brain to the anticipated mass of the brain for a given body size (Jerison, 1970; Martin, 1990). It is essentially nothing more than an index of brain volume that can be compared to different organisms. However, the relationship fails to scale properly across different taxonomic groups of mammals (Pagel and Harvey, 1989). The allometric relationship is traditionally derived from a bivariate regression analysis of brain volume and body weight to determine the degree of encephalization of the animal in question (Sacher, 1970; Martin, 1990). Since a majority of mammals are expected to have an encephalization quotient of 1, a higher encephalization quotient implies the organism is more complex (Jerison, 1970; Martin, 1990; McHenry, 1988).

The australopithecines are an extinct group of creatures alleged to be an early evolutionary branch of divergence from chimpanzees (Ayala and Cela-Conde, 2003). Some believe they are transitional forms that are forerunners to the genus *Homo* (Wood and Collard, 1999; Wood, 1992; Tobias, 1991; Skelton and McHenry, 1992). Others believe they are nothing more than an extinct evolutionary branch (Pilbeam and Gould, 1974), and others believe they are simply an extinct form of ape (Cuozzo, 1977; Custance, 1968; Hummer, 1977; Lubenow, 1992; Mcleod, 1983; Oxnard, 1975; 1984). More importantly however, Pilbeam and Gould (1974) have stated that at least three principal species of *Australopithecus* are all just different adaptations of the same animal and their brains are all equally expanded beyond the ape grade. In this context, evolutionists have elevated the australopithecines to a pseudo-transitional status higher than the pan-troglodytes for no other reason than a larger uncorrected average brain mass.

Louis Leakey et al. (1964) were the first to propose *Homo habilis* as the earliest member of the genus that evolutionists also place modern humans. *Homo habilis* is primarily distinguished from the australopithecines by its larger brain size (Haeusler and McHenry, 2004; Pilbeam and Gould, 1974; Susman, 1994; Blumenschine et al., 2003). *Homo habilis* has been proposed by evolutionists as the earliest hominid to exhibit the increased brain size required to evolve human intelligence. However, the validity of placing this extinct animal in the genus *Homo* has been in significant dispute ever since Leakey's discovery was first published (Wood and Collard, 1999; Kramer et al., 1995; Lieberman et al., 1988; Miller, 2000; Tobias, 2003; Hummer, 1977; Hummer, 1978; Cheek, 1981; Custance, 1968).

The primary goal of the present study is to review different body mass models and determine which is a more accurate predictor of the physical size of *Australopithecus afarensis*, *Australopithecus africanus*, *Australopithecus robustus*, *Australopithecus boisei*, and *Homo habilis*. Encephalization quotients are then recalculated using the accepted body mass model to determine if the evolutionary transitional status for the australopithecines and *Homo habilis* has any scientific validity. Additionally, this paper will evaluate the accuracy of awarding transitional status to the australopithecines over pan-troglodytes.

## Methods of Estimating Brain Mass and Encephalization Quotient

### Brain Mass

The brain mass calculation below is taken from the formula used by Ruff et al. (1997). The equation was first derived by Martin (1981) employing a least squares regression analysis to determine a bivariate relationship of brain mass and cranial capacity using the data from 27 primate species. Ruff's regression equation (below) has a correlation coefficient of 0.995. The brain masses derived in this paper originate from the individual crania of each hominid fossil presented in Table I.

$$\text{Brain mass} = 1.147 \times \text{cranial capacity}^{0.976} \qquad (1)$$

### Encephalization Quotient

The encephalization quotient in the form presented below is taken from Ruff et al. (1997). This equation relates brain mass and body weight, and is derived from a regression analysis of 309 extant placental mammal species with a correlation coefficient of 0.96 (Martin, 1981; Ruff et al., 1997; McHenry and Coffing, 2000).

$$\text{EQ} = \text{brain mass} / (11.22 \times \text{body mass}^{0.76}) \qquad (2)$$

## Discussion

### Determination of Hominid Body Weight

While there have been several papers published attempting to relate various cranial and post-cranial fossils to hominid body weight (Aiello and Wood, 1994; Jungers, 1988; McHenry, 1988; Wolpoff, 1973; Kappelman, 1996), estimations that employ hind-limb joint diameter seems to be the best predictor of total body mass (McHenry, 1992; Jungers, 1988; Ruff and Walker, 1991; Kappelman, 1996). Several proposed regression calculations yield formulae extracted from either human data (McHenry, 1992) or from data that includes all hominoidea (Jungers, 1988; McHenry, 1992; Kappelman, 1996). The body mass formulae evaluated in this paper are based on two models proposed by McHenry (1992) utilizing human data (male and female North Americans, Khoisan, and Pygmy) and hominoid data (extant male and female apes along with the human data). Regressions using the human data assume that the animal in question is an obligatory biped, while regressions based on hominoid data include obligatory bipeds and animals that are facultative biped and quadruped.

Table II is a comparison of several hominid body weight estimates using McHenry's human and hominoid regression formulae. Generally, body mass calculations originating from the human regression formula will bias the data towards lower body weights because obligatory biped animals possess less muscle density in their upper body. Conversely, facultative bipeds or quadrupeds possess a much higher percentage of upper body mass because their primary mode of locomotion involves the use of their upper body extremities.

While some evolutionists continue to question using human data to calculate the body weight of extinct hominids (Jungers, 1988), countless articles have appeared in secular journals presenting data on encephalization quotients focused on calculated extinct hominid body masses originating from formulae based on human models (Aiello and Dean, 2002; Ruff et al., 1997; McHenry and Coffing, 2000; McHenry, 1994a; 1994b; Wolpoff, 1973). When McHenry first proposed his human model, it was not without some skepticism. McHenry (1992) stated, "It is difficult to assess whether human or hominoid formulae give the best results" (p. 421). Jungers (1988) said that "*Homo sapiens* should be omitted from these models because they possess abnormally large hind-limb joints for their body size and this condition does not characterize early hominids" (p.117). It has also been demonstrated that body weight estimations for A. *robustus* and A. *boisei* based on formulae derived from hominoid post-cranial remains correlate much better with their robust jaws than estimations based on human formulae (McHenry, 1991a).

McHenry (1992) has further stated: "Common sense might favor the human equations simply because all known hominids are bipedal" (p. 421). However, generally stating that all known hominids are bipedal is extremely misleading. The australopithecines (A. *afarensis*, A. *africanus*, A. *robustus / boisei*) and *Homo habilis* are all facultative bipedal (Wood and Collard, 1999) which is a very different declaration than just saying they are bipedal. A facultative bipedal animal is one whose primary mode of locomotion

**Table I. Hominid Encephalization Quotient Data Using the Hominoid Body Mass Model**

| SAMPLE | CRANIAL CAPACITY $cm^3$ | BRAIN MASS++ Grams | BODY MASS+ | | ENCEPHALIZATION QUOTIENT+++ | |
|---|---|---|---|---|---|---|
| | | | Male (Kg) | Female (Kg) | Male | Female |
| ***Australopithecus afarensis*++++** | | | | | | |
| AL - 333-45 | 500 | 494 | 60 | 36 | 1.96 | 2.91 |
| AL-162-28 | 400 | 397 | 60 | 36 | 1.57 | 2.34 |
| AL-333-105 | 400 | 397 | 60 | 36 | 1.57 | 2.34 |
| ***Australopithecus africanus*++++** | | | | | | |
| MLD 1 | 500 | 494 | 53 | 37 | 2.16 | 2.84 |
| MLD 37/38 | 435 | 431 | 53 | 37 | 1.88 | 2.48 |
| STS 5 | 485 | 479 | 53 | 37 | 2.09 | 3.76 |
| STS 19/58 | 436 | 432 | 53 | 37 | 1.89 | 2.49 |
| STS 60 | 428 | 424 | 53 | 37 | 1.85 | 2.44 |
| STS 71 | 428 | 424 | 53 | 37 | 1.85 | 2.44 |
| Taung | 405 | 402 | 53 | 37 | 1.76 | 2.31 |
| ***Australopithecus robustus/boisei*++++** | | | | | | |
| L388Y-6 | 448 | 444 | 76 | 40 | 1.47 | 2.38 |
| SK 1585 | 530 | 523 | 76 | 40 | 1.73 | 2.81 |
| KMN-ER 406 | 510 | 504 | 76 | 40 | 1.67 | 2.71 |
| KMN-ER 732 | 500 | 494 | 76 | 40 | 1.64 | 2.65 |
| OH 5 | 530 | 523 | 76 | 40 | 1.73 | 2.81 |
| KMN-WT 17000 | 410 | 407 | 76 | 40 | 1.35 | 2.18 |
| KMN-WT 17400 | 400 | 397 | 76 | 40 | 1.32 | 2.13 |
| KMN-ER 13750 | 475 | 470 | 76 | 40 | 1.56 | 2.52 |
| KMN-ER 407 | 506 | 500 | 76 | 40 | 1.66 | 2.68 |
| KMN-ER 732 | 500 | 494 | 76 | 40 | 1.64 | 2.65 |
| ***Homo habilis*+++++** | | | | | | |
| KMN-ER 1813 | 510 | 504 | 75 | 41 | 1.69 | 2.65 |
| OH 7 | 687 | 674 | 75 | 41 | 2.26 | 3.54 |
| OH 13 | 650 | 638 | 75 | 41 | 2.14 | 3.35 |
| OH 24 | 590 | 581 | 75 | 41 | 1.94 | 3.05 |
| KMN-ER 3732 | 625 | 614 | 75 | 41 | 2.06 | 3.22 |
| KMN-ER 1805 | 582 | 573 | 75 | 41 | 1.92 | 3.01 |
| OH 16 | 638 | 627 | 75 | 41 | 2.10 | 3.29 |
| **Pan-Troglodytes++++++** | 410 | 380 | 49 | 41 | 1.88 | 2.00 |

+ Body masses are using the hominioid model and are obtained from McHenry (1992).

++ Brain Masses are obtained from the equation BM=1.147Xcranial capacity0.976

+++ Encephalization quotients are obtained from EQ=BM / (11.22Xbodymass0.76)

++++ Cranial capacities except for Homo habilis are obtained from Aiello and Dean (2002).

+++++ Homo habilis cranial capacities are obtained from Holloway (2000).

++++++ Cranial capacity and body weights are taken from extant data reported by Pilbeam and Gould (1974).

**Table II. Hominid Body Mass Comparisons Using the Human and Hominoid Formulae**

| | BODY MASS | | BODY MASS | | PERCENT INCREASE+ | |
|---|---|---|---|---|---|---|
| | Human Formula | | Hominoid Formula | | | |
| SAMPLE | Male (Kg) | Female (Kg) | Male (Kg) | Female (Kg) | Male (%) | Female (%) |
| *Australopithecus afarensis* | 45 | 29 | 60 | 36 | 33 | 24 |
| *Australopithecus africanus* | 40 | 30 | 53 | 37 | 33 | 23 |
| *Australopithecus robustus/boisei* | 49 | 32 | 76 | 40 | 55 | 25 |
| *Homo habilis* | 52 | 32 | 75 | 41 | 44 | 28 |

Body weights are taken from McHenry (1992).

+ Percent increase in body weight by using the Hominoid formula over the Human formula.

is brachiation. Wood and Collard (1999) concluded that the *Australopithecus* displayed a mixed locomotor strategy of terrestrial bipedalism with an ability to climb proficiently. Conversely, the participants in the genus *Homo* (except for *Homo habilis*) are characterized by a commitment to modern humanlike terrestrial bipedalism (obligatory bipeds) and a very limited ability for brachiation. *Homo habilis* also had long arms along with interpretations about hand bones strongly suggesting an animal well adapted for apelike tree climbing (McHenry and Berger, 1998; Wheeler, 1992; Susman and Creel, 1979; Marzke, 1997; Mehlert, 2000).

While Wood and Collard (1999) generally concluded that the australopithecines and *Homo habilis* possessed a secondary locomotor strategy of terrestrial bipedalism, others have reported that this terrestrial bipedalism was primarily a postural component that aided feeding (Hunt, 1994; Lovejoy and Heiple, 1970; Straus, 1962). Spoor et al. (1994) stated:

> These observations support studies of the postcranial fossil record which have concluded that *H. (Homo) erectus* was an obligatory biped, whereas *A. africanus* showed a locomotor repertoire comprising facultative bipedalism as well as arboreal climing [sic]. The labyrinthine evidence is consistent with proposals that bipedalism in australopithecines was characterized by a *substantial postural component*, and by the absence of more complex movements such as running and jumping (p.648, emphasis added).

Spoor et al. (1994) further admitted in the same article that their analysis of *Homo habilis*, while speculative, suggested that they relied less on bipedal behavior than the australopithecines.

Although Spoor, Hunt, Lovejoy, et al. believe that macroevolution is fact, they are admitting that the facultative bipedalism attributed to the australopithecines and *Homo habilis* is dominated by a postural component which is primarily used for feeding (similar to the extant great apes) and is completely inconsistent with the more complex human obligatory bipedal movements.

The terrestrial bipedalism exhibited by the australopithecines and *Homo habilis*, even though demonstrated to be nothing more than a postural component, still appears to be the predominant evolutionary criteria for their perceived transitional status and thus links them (however weakly) to humans. However, some evolutionists have argued that the locomotion strategy of the australopithecines actually differed much more from humans than from the African apes (Oxnard, 1984; Verhaegen, 1990; 1993; 1994). Some have stated that the australopithecines could have even possessed exclusive locomotor adaptations characteristic of an environment that no longer exists (Du Brul, 1977; Oxnard, 1984; Puech, 1992; Verhaegen, 1992; 1993).

Extant brachiating animals possess much greater mass in their upper body than obligatory bipeds because their upper body muscles are used more for locomotion purposes. Since the australopithecines and *Homo habilis* are known to be facultative bipeds, a model to calculate their body mass utilizing data only extracted from extant obligatory bipeds (humans) would result in an inaccurate number. A model recognizing the greater upper body mass of brachiating animals, with which the australopithecines are more closely associated, should produce a body weight number that is much more accurate. As an example, calculations using the McHenry hominoid model over his human model results in an average body mass percent increase of ~41% for males and ~25% for females. This data is shown in Table II.

## Encephalization Quotients of the Hominids

Table I presents the measured cranial capacities, calculated brain masses and corresponding encephalization quotients

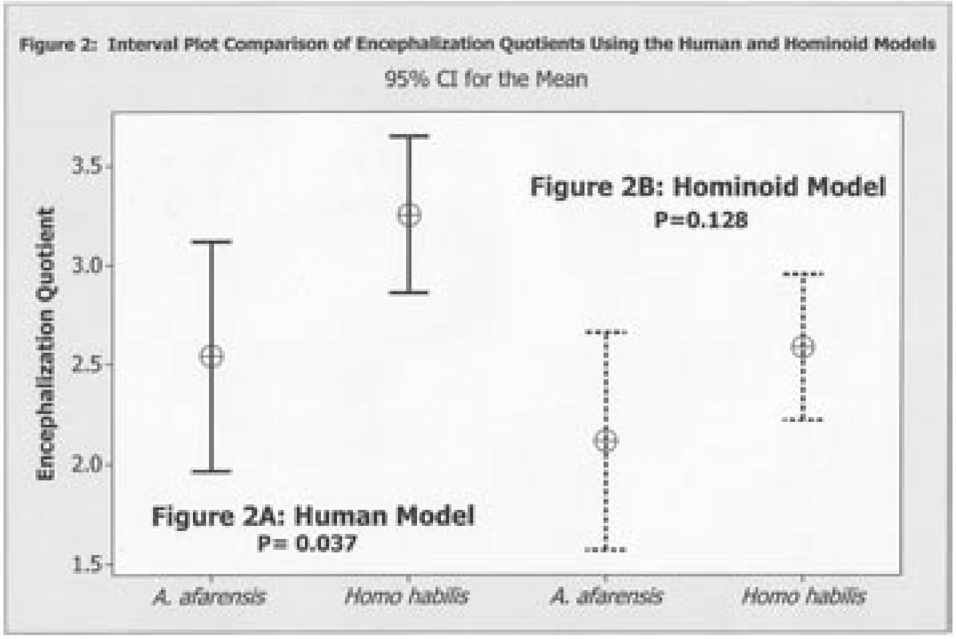

**Figure 2. Interval plot comparison of encephalization quotients using the human and hominoid models**

for several hominid species, including *Homo habilis*. This paper will abide by the convention of Aiello and Dean (2002) and combine the endocranial volumes of A. *robustus* and A. *boisei* into one species for analysis purposes. Endocranial volumes for the hominids in question are taken from the Encyclopedia of Human Evolution and Prehistory (Holloway, 2000).

Some evolutionists have proposed that the fossil cranium KNM ER 1470 should be identified as *Homo habilis* (Blumenschine et al., 2003; Tobias, 1987; Aiello and Dean, 2002; Holloway, 1988). However, this claim continues to be in dispute (Walker and Shipman, 1996; Holloway, 2000; Lubenow, 1992; Ayala and Cela-Conde, 2003; McHenry and Coffing, 2000). So the cranial data of KNM ER 1470 will not be included as *Homo habilis* in this study.

Encephalization quotient calculations typically use data that are a statistical average of brain mass and body mass (Holloway, 1988, 2000; Aiello and Dean, 2002). However, the sexes of very few crania (if any) are actually known (McHenry, 1991b). This is principally because the discovery of intact crania with associated post-cranial fossils is very rare, resulting in sample sizes too limited to obtain a statistically valid average. Furthermore, White (1998) has previously stated that the coefficients of variation for endocranial capacities in modern great ape and human samples can range between 8% and 15%. Since there is no reason to believe that the coefficient of variation in endocranial capacity for the australopithecines and *Homo habilis* would be any different (Lockwood and Kimbel, 1999), and we do not know the sex of the crania in this study, encephalization quotients will be calculated using numbers that represent the widest range of calculated body masses for both male and female published in the literature. Also, since it has been demonstrated in this paper that the hominids in question are facultative bipedal, body masses originating from the hominoid model will be used to calculate the encephalization quotients and then compared to corresponding quotients originating from the human model. The final numbers should then represent the widest statistical scope of encephalization quotients conceivable from known published data.

Figure 2 is an interval plot comparing the encephalization quotients of A. *afarensis* and *Homo habilis* using human and hominoid body mass estimates, respectively. The first interval plot (Figure 2A) uses human body mass estimates and produces encephalization quotients that result in a p-value of 0.037. A p-value this low rejects the null hypothesis and says that within a 95% confidence, *Homo habilis* is more highly encephalized than A. *afarensis*. The second interval plot (Figure 2B) uses hominoid body mass estimates and generates a p-value of 0.128. A p-value of 0.128 accepts the null hypothesis and says that within a 95% confidence, *Homo habilis* is not more encephalized than A. *afarensis*. So by changing the human model to the hominoid model to accurately represent the facultative bipedalism of *Homo habilis* and A. *afarensis*, the calculated encephalization quotients of both creatures are statistically inseparable.

## Sexual Dimorphism

An encephalization quotient is calculated as a corrected ratio of brain mass to body mass for a particular organism. However, Table II demonstrates the well-known fact that the australopithecines and *Homo habilis* are sexually dimorphic (Johanson and White, 1979; McHenry, 1986; 1991a; Zihlman, 1985). Since body mass is in the denominator of the ratio in question, it is the low body weight of the dimorphic female that is the primary contributor to a higher calculated encephalization quotient. Given that the sex of very few (if any) fossilized crania of these creatures is known, it is possi-

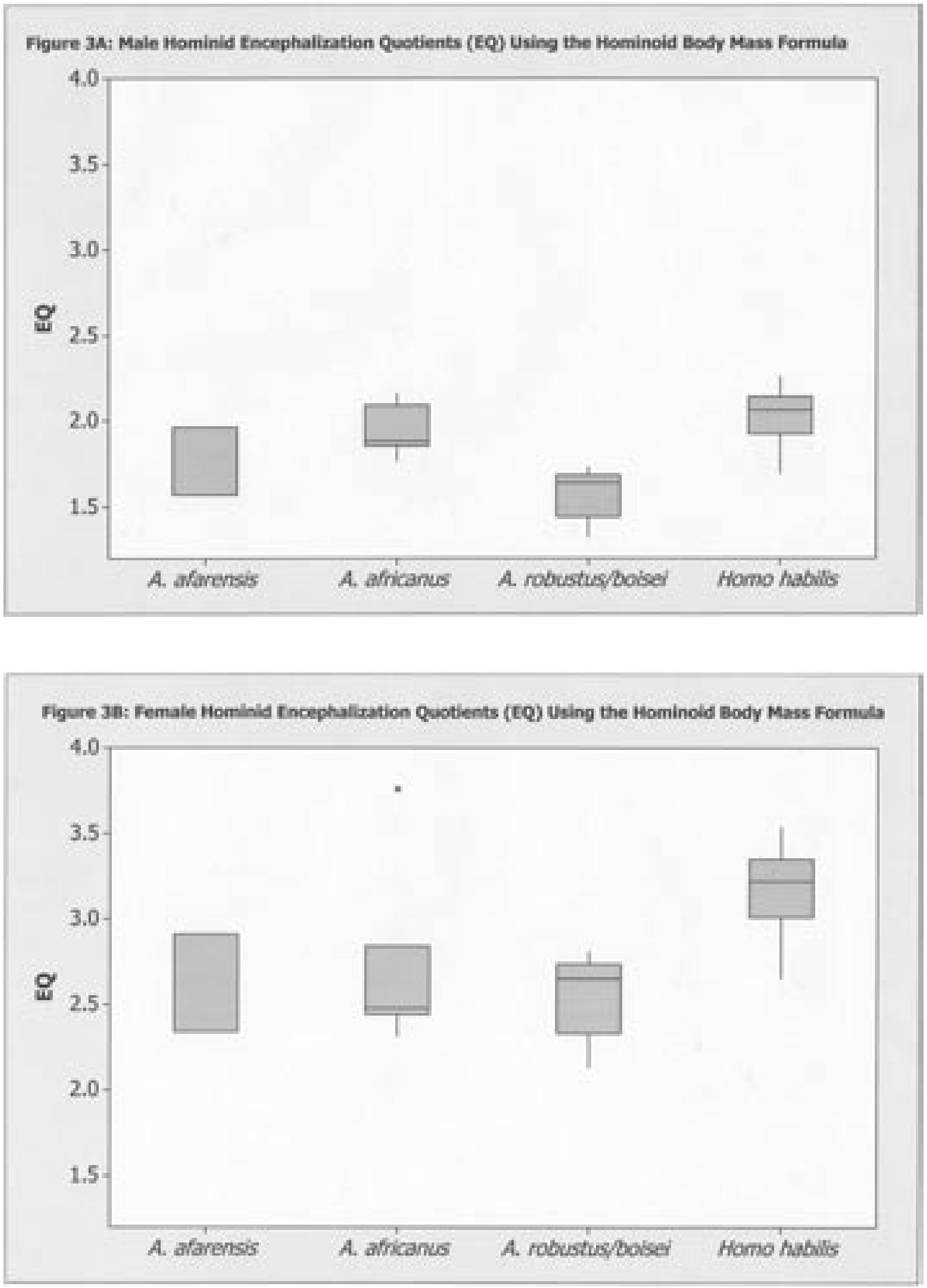

**Figure 3. Male (A) and Female (B) hominid encephalization quotients using the hominoid body mass formula.**

ble that all known specimens (or a majority) could originate from only one of the sexes. Figures 3A and 3B are box plots of the australopithecines and *Homo habilis* encephalization quotients using male and female calculated bodyweights, respectively. Figures 3A and 3B demonstrate that the primary origin of the perceived degree of encephalization increase of *Homo habilis* over the australopithecines is from the calculated body weight of the sexually dimorphic female.

When only male calculated bodyweights are used (Figure 3A), the encephalization quotients of the australopithecines and *Homo habilis* are essentially the same.

## Australopithecines and Pan-Troglodytes

Evolutionists have also presented data comparing the ratio of brain mass to body mass (using the human model) versus evolutionary time as an attempt to demonstrate that extinct australopithecines are a more highly evolved version of the pan-troglodytes. Figure 4 is a scatter plot comparing the ratios achieved when using body masses originating from both the human and hominoid models. When the hominoid model is used to calculate the ratio of brain mass to body mass, the degree of brain expansion of the australopithecines and pan-troglodytes are essentially the same.

## Australopithecines and *Homo habilis*

The coefficient of variation for brain mass of *Homo habilis* is 9.14% (n=7). Lockwood and Kimbel (1999) have stated that there is no reason to believe that the coefficient of variation for these extinct creatures should not be as wide as 15%, just like extant humans and apes. Statistically, this means that *Homo habilis* could have a brain mass of 405 grams and still have a coefficient of variance less than 15%. A *Homo habilis* brain mass of 405 grams is well within statistical variation of brain masses calculated from australopithecine fossilized crania. Hence, when proper body mass estimates are utilized and data are corrected for known statistical variation, these extinct creatures (A. *afarensis*, A. *africanus*, A. *robustus* / *boisei*, *Homo habilis*), are shown to have the same degree of encephalization as extant species of apes.

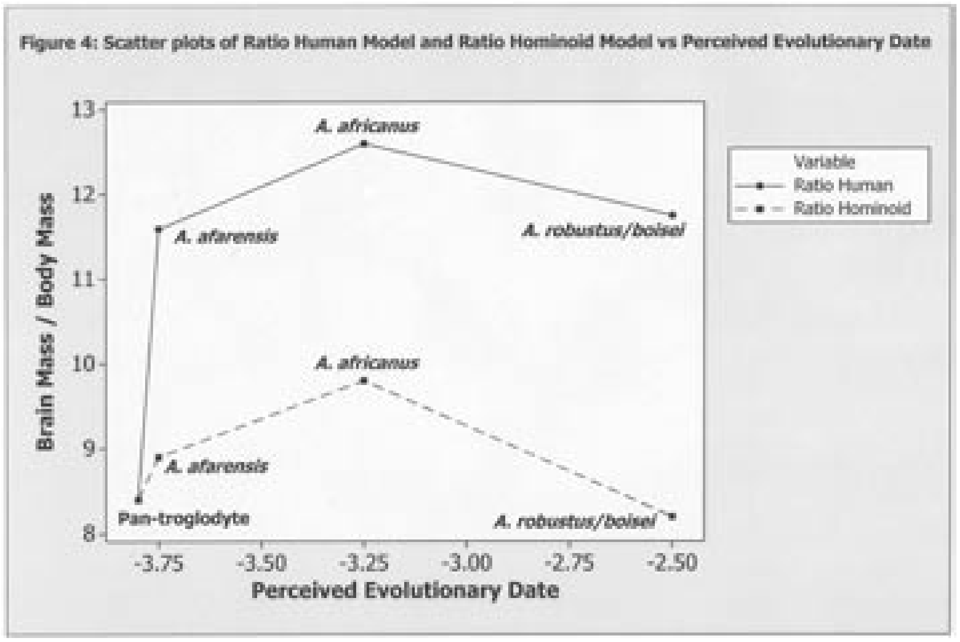

**Figure 4. Scatter plots of the ratio human model to ratio hominoid model versus perceived evolutionary date.**

## Summary

All of the australopithecines including *Homo habilis* are facultative bipedal with brachiation as a primary mode of locomotion. Their terrestrial bipedalism is heavily dominated by a postural component. A brachiating animal must have more mass in the upper body than obligatory bipeds (humans) because of their primary locomotion repertoire. A model for calculating body mass that only includes obligatory bipeds would be skewed to an abnormally small value because of the obvious upper body mass differences of a facultative biped compared to an obligatory biped. Hence a model that includes data from animals that practice brachiation, etc. would more accurately predict the true body mass of the australopithecines and *Homo habilis*.

When a body mass model based on McHenry's (1992) hominoid data is used in encephalization quotient calculations, the brain advancement of *Homo habilis* and the australopithecines is statistically the same. Evolutionists have embraced *Homo habilis* as the first step upward in brain mass that eventually led to humans. Within statistical error, when body mass calculations are corrected for (1) a primary locomotor strategy of brachiation, (2) a terrestrial bipedalism that is postural, and (3) known sexual dimorphism, it is no more encephalized than the australopithecines and pan-troglodytes.

Australopithecines are generally labeled as "hominids" because there are features they lack that are epitomized in the living apes and they exhibit what is interpreted as humanlike attributes. However, it is frequently argued that their perceived humanlike characteristics might just be primitive because many of these characteristics are found in premature African apes. They certainly are not more encephalized than extant chimpanzees. Therefore it is more probable that the australopithecines are phylogenetically connected to African apes and should not be considered an evolutionary transitional link toward becoming humans (Kleindienst, 1975; Goodman, 1982; Oxnard, 1975; Hasegawa et al., 1985; Edelstein, 1987; Verhaegen, 1990; 1994).

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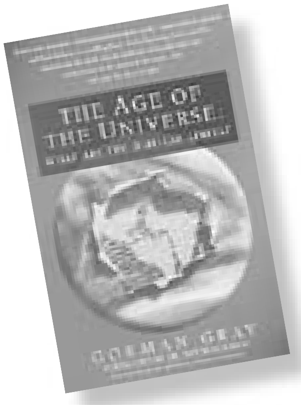

# Book Review

## *The Age of the Universe: What are the Biblical Limits?*
**by Gorman Gray**

**Morning Star Publications, Washougal, WA, 2005, 202 pages, $15.00.**

The author describes himself as an “undefined age biblical literalist.” He interprets the Bible to require a young biosphere (i.e., a recent, literal six-day creation) but to permit both the earth and the stellar heavens to have an unspecified time of origin. “This allows for a possible or probable old universe and planet earth but requires all biology to be less than 8000 years old” (p. 1). The rationale behind this belief is the thought that “if the Bible is reliable and if science is also trustworthy, there should be no conflict whatsoever. …Perfect harmony… must result from demonstrable science and an inerrant word of God” (p.13). Gray states, “Scholars have a right to examine credentials and appraise the source. Because this book is essentially Bible interpretation, a privilege enjoyed by every believer, the only credentials I need to offer are the results” (p.16).

The concept that Gray presents is not new but has existed for many years. M’Clintock, writing in 1878, said, “there is an indefiniteness of the time of creation. It may have been millions of years ago just as easily as thousands, for the Hebrew word is indefinite…” (vol. II, p. 556). It should be noted that M’Clintock does not take a position but merely states the views of various scholars. He does not use the word “probable” as Gray does, but simply says that some scholars believe the time *could* have been millions of years or thousands of years. M’Clintock also writes, “DeLuc, in 1799, wrote the chronology of Moses as only commencing with the creation of man …that the first sentence of Genesis has no connection with the subsequent verses …” (vol. III, p. 796). Gorman Gray has not arrived at a new concept based upon Bible interpretation but is merely reiterating what others said long ago.

Why then has Mr. Gray become so adamant about the time? In his reading of *Genesis* he notes that on day four God brought forth the sun and moon and that God made the stars also. Mr. Gray wants the Bible to agree with contemporary science, i.e., light from the stars would not be immediately visible but would take many years to reach an observer on the earth. Therefore, according to Gray, God could not have made the stars on day four but instead made the stars at some time before day one and therefore the option put forth by Gray for millions of years elapsing between Genesis 1:1 and Genesis 1:2. Biblical scholars and possibly many lay people who read Gray’s book will undoubtedly seize upon some standard historical objections, including Genesis 1:1-5, Exodus 20:11, Genesis 1:16,and Mark 10:6. But Gray has anticipated this and answers such objections even before his readers raise them.

Genesis 1:1-5 is the very heart of the theory that Gray has resurrected. Objectors to the theory, and there have been many, will point out that whatever occurredprior to the statement “and there was evening and morning, the first day,” in Genesis 1:5, must have occurred on that first day. But Gray claims that Genesis 1:1 must be separated from what follows. He also says that it is not a summary or an introduction because what follows in verse two describes events that happened on the earth so the creation of the earth must have happened prior to that time, i.e., prior to the events in verse two.

In many translations Exodus 20:11 reads, “For in six days the Lord made the heavens and the earth, the sea, and all that is in them...” For many readers that would be the clincher to prove Gray wrong. But he claims that the sun and stars were created as described in verse one before there were any days on the earth, and therefore Exodus 20:11 really means that God created all life on the earth, including that in the seas, in six days. Most creationists probably would say that Genesis 1:16 means that the sun, moon, and stars were created on day four. Gray’s argument is that the word “asah,” translated as “made” does not mean “created” since he believes the sun, moon, and stars were created in Genesis 1:1. He states that in many other verses the word “asah” is translated as “made” in the sense of “done,” but not “create.”

Jesus’ own words in Mark 10:6 were “But from the beginning of creation God made them male and female…” That would appear to mean that God had made Adam and Eve during the six days of creation (at the beginning), ruling out creation of anything millions of years before that event. How does Gray refute this? He counters by quoting Proverbs 8, “Yahweh possessed me (Wisdom) in the beginning of his way, before his works of old. I was set up from everlasting, in the beginning, before the earth was.”

From this Gray concludes that there was a beginning before the earth was. This is easily refuted because the verse refers to God's wisdom. His wisdom, like God himself, has existed forever and did not come into being by a creative act of God.

Objectors to the theory proposed in Gray's book do not use Job 38:1-11in rebuttal because this merely describes things that God did at the beginning of creation, but Gray cites these verses repeatedly because of the statements by God that He had made clouds the sea's garment and thick darkness its swaddling band. Gray claims that it was this thick darkness that prevented light from the sun from getting to the surface of the sea, because Gray firmly believes that the sun was not created on day four as stated in Genesis 1:16.

Gray does cite many reasons for believing that Genesis 1:1 does not belong with Genesis 1:2-31, reasons that other writers have used in the past. He has reported agreement with the theory by some Hebrew scholars, notably Dr. David Eckman, Associate Professor of Hebrew, who wrote the Foreword to Gray's book. Other creationists can counter by quoting numerous Hebrew scholars who believe that Genesis 1:1 describes events that happened on day one.

Gray's reasons for believing as he does about the first verse of Genesis may well be acceptable to some readers because of his appeal to logic but also because of the intense desire to resolve the conundrum of how stars could be seen within days after their creation. However, the 8-year RATE project, carried out by scientists of the Creation Research Society and the Institute for Creation Research, has now very effectively shown that the earth is 6000 ± 2000 years old, based upon several factors, including helium retention in zircon crystals, radiohalos in granite, and fission tracks in zircons (DeYoung, 2005). Although the solution of the problem of how Adam and the people of his time could see stars remains to be solved, many creationists will now be bolstered in their belief of the infallibility of God's word because of the success of the RATE project, and it is this writer's opinion that Gray will continue to find himself in the minority.

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Clifford L. Lillo
cllbml@msn.com

# Neogene Sand-to-Pebble Size Siliciclastic Sediments on the Florida Peninsula: Sedimentary Evidence in Support of the Genesis Flood

Carl R. Froede, Jr.*

## Abstract

**The uplift and erosion of the southern Appalachian Mountains provided geologic materials that were transported southward across the Atlantic and Gulf Coastal Plains. For a period of time the Suwannee Strait/Gulf Trough separated clastic sedimentation on the coastal plain from carbonate deposition out on the Florida Peninsula. Once the terrigenous sediments bridged this impediment, they rapidly spread southward across northern Florida. Subsequent regional tilting and widespread erosion along the Florida peninsula subjected these coarse siliciclastic sediments to further transport, eventually propelling them to the northern Florida Keys. In the Naturalist interpretation we would expect the particle size of the transported sediments to diminish southward across the peninsula due to both mechanical and chemical weathering over the purported millions of years. However, the identification of quartzite pebbles beneath the northern Florida Keys raises questions about this uniformitarian expectation. An alternative interpretation based on the consistent average quartz pebble particle size extending the length of the Florida Peninsula would suggest that the geologic energy necessary to erode, transport, and deposit the siliciclastic sediments from the southern Appalachians to the northern Florida Keys (approximately 650 miles) is better understood within the high energy framework of the global Flood of Genesis.**

## Introduction

The Florida peninsula is composed of a variety of geologic materials (e.g., sands, silts, clays and carbonates). Uniformitarian geoscientists have proposed that over the course of millions of years, the southern Appalachians shed siliciclastic sediments southward over the Atlantic and Gulf Coastal Plains and eventually across the submerged carbonate Florida Peninsula. Extensive quarrying, drilling, and coring along the peninsula have revealed a stratigraphic layer that is consistent with this expectation. The quartz-rich sediments range in size from fine-grained sands to quartzite pebbles, some up to three inches (7.6 cm) in their longest dimension, but more typically in the 1.5 inch (3.8 cm) range. The siliciclastic sediments extend down the entire length of the Florida peninsula (Pirkle, 1960; Pirkle et al., 1964; Winker and Howard, 1977a; Warzeski et al., 1996; Cunningham et al., 2003).

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* Carl R. Froede Jr., B.S., P.G., 2895 Emerson Lake
Drive, Snellville, GA 30078-6644
Accepted for publication: July 22, 2005

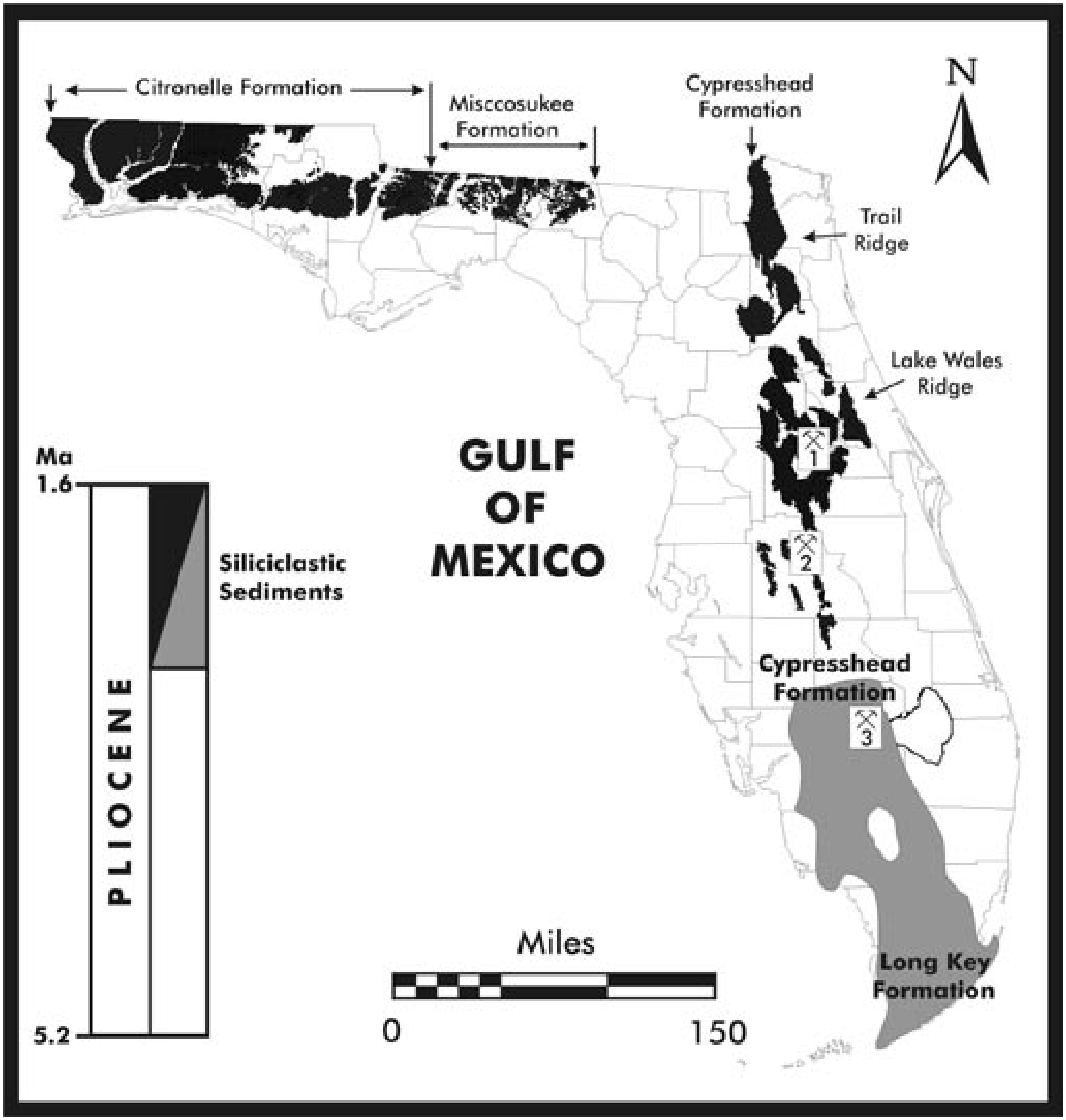

Figure 1. Geologic map showing the surface exposures (in black) of siliciclastic sediments that contain sand to pebble size quartz material derived from the southern Appalachian Mountains (Modified from Scott, 2001; Warzeski et al., 1996). The Cypresshead and Long Key formations in south Florida are in the subsurface and shaded gray. Scott (2001) has defined all of these quartz-rich sediments to the upper Pliocene. Surface mines where quartz pebbles were collected are shown in the three areas with crossed pickaxes. The volume and dimensions of the quartz sediments that extend the entire length of the peninsula demonstrate the tremendous geologic energy expended during the Flood.

An investigation was conducted to determine if the siliciclastic sediments (i.e., quartzite pebbles and coarse sand particles) could be linked as a single lithostratigraphic unit along the entire length of the Florida Peninsula and to ascertain the timing and nature of the geologic forces necessary to erode, transport, and deposit this material from the Southern Appalachians to the northern Florida Keys.

## Pliocene Sediments

Geologists working across Florida have long been aware of the siliciclastic surficial sediments that extend across much of the State. Age dating these materials has proven to be problematic as paleontological material is generally lacking. The similar lithology of these sediments and their overall homogeneity had relegated them to a single lithostratigraphic unit that correlates to the Neogene Period (i.e., Miocene and Pliocene Epochs). More recently, Scott (2001) assigned this lithostratigraphic unit strictly to the Upper Pliocene. These coarse-grained clastic sediments have been identified in: 1) the Citronelle Formation along the western panhandle, 2) the Miccosukee Formation on the eastern panhandle, 3) the Cypresshead Formation along the peninsula, and 4) the Long Key Formation in the subsurface of south Florida (Figure 1). The scope of this investigation was limited to the stratigraphic units that contain siliciclastic sediments ranging in size from sand (1/16 mm to 2mm) to pebbles (specifically in the range of 4 mm to 5 cm) consistent with the modified Wentworth grain-size scale for siliciclastic sediment (Ingram, 1989).

### Citronelle Formation

Before 1916, geologists identified the “Orange sand” of the Gulf Coastal Plain by many different stratigraphic names. Matson (1916) was the first to name and define the geological type section near Citronelle, Alabama, and Berry (1916) dated the Citronelle Formation to the Pliocene Epoch. However, this has not gone unchallenged due to the poor paleontological content of the sediments (Roy, 1939; Carlston, 1951; Stringfield and LaMoreaux, 1957; Doering, 1958; Isphording and Lamb, 1971). More recently, Otvos (1998a, 1998b, 2004) identified the Citronelle Formation as the most extensive surficial stratigraphic unit between the Mississippi River and east Florida, and he age-dated this formation to the Upper Pliocene based on recent pollen discoveries (1998b, 2004).

Regarding the Citronelle Formation in Florida, Scott (1991) stated:

> As it is currently recognized, the Citronelle Formation occurs only in the panhandle. The unit is recognized from central Gadsden County on the east to the western boundary of the State. The Citronelle Formation is composed of very fine to very coarse, poorly sorted, angular to subangular quartz sand. The unit contains significant amounts of clay, silt and gravel which may occur as beds, lenses or stringers and may vary rapidly over short distances (p. 10).

Otvos (1998a) set the Citronelle depositional paleoenvironment as:

> ...coarse- and fine gravelly sands deposited in major and minor stream channels, substantial fine-grained floodplain and channel-fill lithosomes and widespread, locally predominant finegrained [sic], rarely organic-rich floodplain units. Cyclic interlayering of fine and coarse-grained beds and indications of channel bank erosion (minuscule-to-sizable clay/mud clasts) and reworking are very common and stream meander-indicative lateral accretion beds absent (p. 1788).

### Miccosukee Formation

The Miccosukee Formation has limited distribution across the eastern panhandle. It was originally named by Hendry and Yon (1967) for outcrops found across Jefferson and Leon Counties and dated to the Upper Miocene.

Hendry and Yon (1967) describe the Miccosukee Formation as:

> ...composed of continental interbedded and cross-bedded clay, sand and gravel of varying coarseness and admixtures. Most of the strata show lateral changes in thickness, stratification, texture, and composition even though the deposits are widespread (p. 252).

Scott (1991, 2001) stated that the Miccosukee extends from eastern Madison County and transitions through a broad facies moving west where it eventually grades into the Citronelle Formation in Gadsden County, Florida. The Miccosukee is no longer considered Miocene but Upper Pliocene (Scott, 2001) despite the discovery of Miocene age fossils of horse and rhinoceros teeth contained within it (Yon, 1965).

### Cypresshead Formation

The Cypresshead Formation was first used by Huddlestun (1988) to describe Pliocene strata that predates the Pleistocene terraces of southeastern Georgia. Scott (1988a) extended the formation into Florida.

According to Scott (2001), the Cypresshead Formation:

> ...is composed of siliciclastics and occurs only in the peninsula and eastern Georgia. It is at or near the surface from northern Nassau County southward to Highlands County forming the peninsular highlands....The Cypresshead Formation consists of reddish brown to reddish orange, unconsolidated to poorly consolidated, fine to very coarse

> grained, clean to clayey sands. Cross bedded sands are common within the formation. Discoid quartzite pebbles and mica are often present. Clay beds are scattered and not areally extensive. In general, the Cypresshead Formation in exposure occurs above 100 feet (30 meters) above mean sea level (msl)….It appears that the Cypresshead Formation occurs in the subsurface southward from the outcrop region and similar sediments, the Long Key Formation, underlie the Florida Keys (p. 20).

### Long Key Formation

Well cores obtained from locations in the northern Florida Keys have revealed an extensive siliciclastic layer within the subsurface (Ginsburg, Browne, and Chung, 1989). This unit was originally defined within the Peace River Formation (Warzeski et al., 1996) but was later renamed the Long Key Formation due to the significant lithostratigraphic differences between this unit and the bounding carbonate strata (Cunningham et al., 1998).

The Long Key Formation is identified as:

> ...a succession of subsurface siliciclastics up to 145 m [476 feet] thick underlying southernmost Florida... (Cunningham et al., 1998, p. 249, brackets added).

The lithofacies characteristics of the Long Key Formation are derived from a single well core on Long Key (W-17156, FGS-Long Key No. 1) and the formation is described as an unconsolidated to poorly consolidated quartz sand or sandstone with particle sizes ranging from silt to pebble (Cunningham et al., 1998).

Two other well cores in the northern Florida Keys (i.e., one at Marathon and another at Silver Shores) also exhibited an extensive interval of quartz sands and pebbles. According to Warzeski et al. (1996), the Marathon well (W-12799) "... contains a 44 m [144 ft] thick section of rounded granule- and pebble-size grains of quartz or phosphate in a matrix of clean, fine to course, white quartz sand" (p. 791, brackets added). The core at Silver Shores (W-12973) contained a 164-foot-thick (50 m) siliciclastic layer with quartz pebbles identified in the middle of the section (Warzeski et al., 1996).

This massive siliciclastic layer is bounded in the subsurface by carbonate units. The upper carbonate layer varies in thickness from 33 feet (11 m) south-southwest of Miami, to 131 feet (40 m) in the northern Florida Keys (Warzeski et al., 1996), and forms the Quaternary carbonate shelf and coral reef tract (Enos and Perkins, 1977).

## Depositional Setting

### Florida Peninsula – Cypresshead Formation

A wide variety of depositional settings have been suggested by uniformitarian geologists to explain the siliciclastic sediments and kaolinitic clays along the Florida peninsula. Davis (1916) suggested that the clays were likely deposited on a floodplain. Investigation of the cross-bedded quartz sands and pebbles in the Lake Wales Ridge of the central Florida peninsula led Bishop (1956) to suggest that the sediments represented deltaic foresets. Altschuler and Young (1960) interpreted the sand deposits to be the result of intensive lateritic weathering of the former sediment mantle that stretched across the Florida Peninsula. Klein et al. (1964) suggested that the quartz pebbles in Hendry County, Florida, represented a channel lag of a deltaic finger that progressed southward across Highlands County during the Late Miocene. The idea of a large prograding river delta moving southward down the Florida peninsula has also been advocated by several geologists working across this portion of the State (e.g., Pirkle et al., 1964; Puri and Vernon, 1964; Peacock, 1983).

However, the concept of a river flowing down the peninsula has not met with complete acceptance. Winker and Howard (1977a) stated that:

> It is difficult to understand why a major river, presumably originating in Georgia, should avoid the most direct routes to the sea, such as the Altamaha and Apalachicola Rivers follow today, and proceed for a few hundred kilometers almost down the center of an active structural arch, to deposit its bedload as a number [of] long, parallel sand ridges (p. 417, brackets added).

Regarding the likelihood of a Neogene age river prograding down the Florida peninsula, Hine (1997, p. 172) stated that, "Most likely, there were no south- or east-flowing sediment-bearing streams on the Florida Platform south of the present St. Johns River."

Other investigators have proposed that the coarse, clastic sediments reflect a nearshore marine depositional setting best represented by longshore transport (Bell, 1924; Martens, 1928; Cooke, 1945; Hoyt, 1969; Alt, 1974; Winker and Howard, 1977a; Kane, 1984; Hine, 1997).

That siliciclastics extend along the entire length of the Florida peninsula is not debated. However, the postulated depositional setting remains unresolved and open for further discussion. It should be noted that the size of the quartz pebbles and manner of sediment mixing does not appear to be an impediment to either depositional model. However, for the larger particles found along the peninsula, Pirkle et al. (1964, p. 1125) stated that, " ...the Citronelle sediments were swept by strong currents is evidenced by the transportation of quartz granules and quartzite pebbles...."

### South Florida – Long Key Formation

In south Florida, the nature and form of the subsurface quartz-rich sand and pebble deposits initially led investigators to suggest that the paleosetting was a nearshore beach to barrier island environment. According to Warzeski et al. (1996):

> This pathway of maximum paleocurrents, about 100 km [62 miles] wide, is interpreted as the palimpsest record of unusually strong, southward-moving shoreline and channel deposition or a giant prograding spit. The ultimate source of these siliciclastics is from the Appalachians, approximately 1000 km [621 miles] to the north. We contend that southward entry of the siliciclastics into southernmost Florida was deflected eastward by west-to-east channeled flow of an ancestral Florida Current (p. 788, brackets added).

These siliciclastic sediments spread across the south Florida platform in channels up to 164 feet (50 m) deep across a broad area 62 miles (100 km) wide (Warzeski et al., 1996). Seaward of the Keys these sands form geometries suggestive of slump deposits which have been reworked by contour currents resulting in contourites (Warzeski et al., 1996). These types of deposits (i.e., contourites) are more typically associated with deep water currents and suggest that the water level during the time the sands were prograding southward might have been much deeper than is presently understood.

However, the prograding spit concept is not the only depositional model suggested to explain the siliciclastic sediments found in south Florida. Some geoscientists view these deposits as having formed within a fluvial/deltaic setting. In describing the size and form of the quartz-rich sediments extending across south Florida, Cunningham et al. (2003) stated that:

> ...the width and thickness of this set of clinoforms is comparable to the Holocene Balize and Plaquemine deltaic lobes of the Mississippi River. However, we do not propose that the huge height and width of the aggrading complex of clinoforms are evidence of a fluvial system the size of the Mississippi delta, but the large size of the clinoform complex does suggest a depositional system that is unprecedented in scale relative to any fluvial or coastal marine depositional system operating today in the eastern Gulf of Mexico (p. 42).

To explain the somewhat laterally confined nature of the large-scale fluvial-deltaic strata, Cunningham et al., (2003) further proposed that:

> Antecedent relief, present on the upper sequence boundary at the top of SS1, funneled the inferred delta axis southward along the middle of the Florida Platform. If the deltaic interpretation of the Caloosahatchee River seismic data is correct, then the Late Miocene–Early Pliocene siliciclastics beneath the middle and northern Florida Keys were probably transported about 200 km [124.3 miles] southward in association with Late Neogene fluvial-deltaic progradation (p. 43, brackets added).

Two different uniformitarian depositional models can be invoked to explain the siliciclastic sediments found in south Florida. Unfortunately, the nature of the sediments does not readily yield itself to a clear depositional model within the uniformitarian framework. However, the particle size of the quartz pebbles requires considerable energy.

## Tectonism and the Suwannee Strait

According to uniformitarian interpretation, the southern Appalachian basement became exposed at some point following the termination of the Alleghenian orogeny which ended 300 Ma. The igneous basement rocks, specifically the quartzite materials, provided the source sediments for the Neogene siliciclastic sediments found across the Atlantic and Gulf Coastal Plains. These terrigenous sediments were carried southward across the coastal plain but did not continue down the Florida Peninsula until the Suwannee Strait/Gulf Trough was crossed (Dall and Harris, 1892; Hull, 1962; Puri and Vernon, 1964; Husted, 1972; Pinet and Popenoe, 1985; Popenoe et al., 1987). (It should be noted that the Suwannee Strait and Gulf Trough are often confused as they generally occur along the same axis. The Suwannee Strait extended from modern Apalachicola, FL to Charleston, SC. It is interpreted as a broad channel connecting the Gulf of Mexico to the Atlantic. The Gulf Trough is more typically interpreted as a structural embayment that extended from Apalachicola to near McRae, GA. It did not connect the Gulf to the Atlantic. They both served as barriers to the southward transport of siliciclastic sediments and are thus combined here.)

Cunningham et al. (2003) provides a concise summary explaining the uniformitarian geologic history of the Suwannee Strait:

> From the Middle Cretaceous to the Late Paleogene, a structural low called the Suwannee Strait or Gulf Trough separated the carbonate Florida Platform from a clastic shelf and slope at the southeastern part of modern North America, and was key to maintaining carbonate sedimentation on the platform. In the Middle Cretaceous a strong current began to flow through this low Suwannee Strait or Gulf Trough creating a sharp facies boundary between siliciclastics originating in the southern Appalachians to the north and the carbonate mega-platform to the south. Currents moving through the seaway from the Gulf of Mexico to the Atlantic precluded transport of siliciclastic sediment and nutrients from interrupting carbonate growth on the Florida Platform. Development of a paleo-Florida current during the Paleocene to Early

> Eocene (?) weakened the current through the Gulf Trough, and in conjunction with inferred uplift of the Appalachian Mountains, contributed to infilling of this seaway. The Gulf Trough was closed by the Late Eocene, allowing the dispersal of siliciclastics to the eastern part of the Florida Platform, where they mixed with carbonates during the Oligocene to Late Miocene (p. 31).

Numerous arches and basins occur along the entire length of the Florida peninsula (Figure 2). Originally, several of these features were interpreted to be the result of tectonism that occurred during the Tertiary (Puri and Vernon, 1964; Hoyt, 1969; Galloway et al., 1991; Riggs et al., 1991). More recently, it has been proposed that no tectonic deformation or orogenic activity occurred along the peninsula during the Cenozoic and these arches and basins are the result of regional tilting, karstification, and differential erosion (Winston, 1976; Winker and Howard, 1977b; Opdyke et al., 1984; Scott, 1988b, 2001; Smith and Lord, 1997). However, not everyone is in agreement, at least not for south Florida (Cunningham et al., 1998) and the role that tectonism and subsidence played in the funneling of siliciclastic sediments along the Florida peninsula to the south Florida Basin is being further explored.

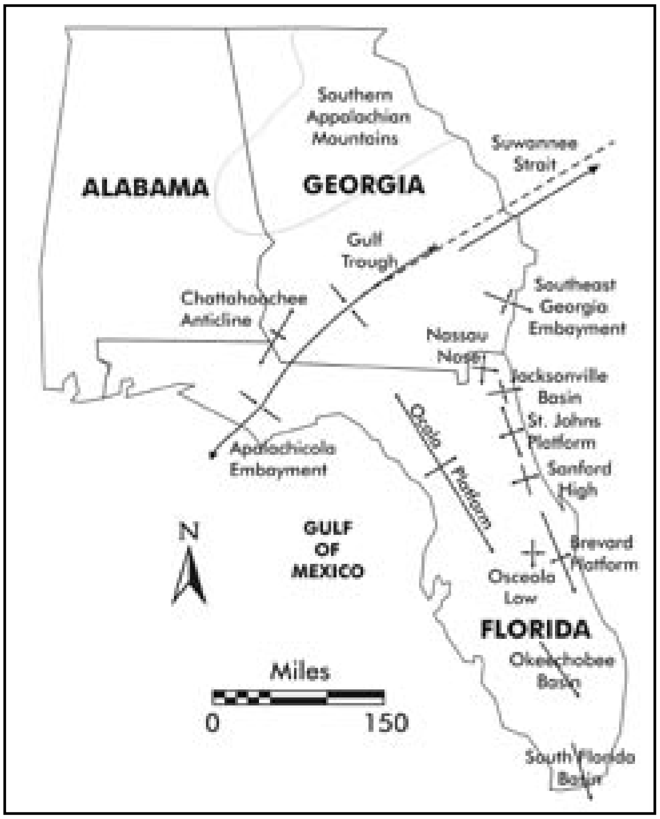

**Figure 2. Most of these geologic structures are interpreted by uniformitarians to have formed before the Tertiary; however, questions remain. The Suwannee Strait/Gulf Trough features occur along the same axis with the Strait extending all the way to the Atlantic. The Gulf Trough only extended across a portion of the Georgia Coastal Plain. The arrow points in the perceived water flow direction. Within the Creation/Flood framework it is postulated that the numerous geologic structures identified on this map formed during the Flood and those along the Florida Peninsula enhanced the southward transport and deposition of the siliciclastic sediments. Modified from Scott (2001).**

## Sea Level Changes and Siliciclastic Deposition

According to uniformitarian interpretation, the deposition of Cretaceous and Tertiary sediments across the southeastern United States is related to the slow withdrawal of global sea level. The blanket of siliciclastic sediments that formerly extended across northern Florida and down the Peninsula has been partially eroded away leaving such prominent elevational features as the Trail Ridge and Lake Wales Ridge. Accommodating the deposition of these quartz-rich sediments along the elevated Florida Lake Wales Ridge in central Florida would require a sea-level position approximately 140 feet (42.7 m) higher than at present (Pirkle et al., 1964).

## Discussion

Sedimentologists have documented the relationship between particle size and transport distance. Predictably, the particle diminishes in size the farther it is transported. Of course, many factors such as hydraulic gradient, material hardness, and abrasiveness of the load all play a part in the breakdown of the transported materials. However, the consistent average size of the quartzite pebbles found along the entire length of the Florida Peninsula does not appear to correspond to the particle size expected when considering the transport distance and duration in which this is purported to have occurred (Figures 3, 4, 5, and 6). This was a highly unusual and energetic setting in any postulated uniformitarian depositional model.

The velocity and volume of water necessary to transport rounded and flattened pebbles from the southern Appalachians to the northern Florida Keys is perplexing. While significant topographic relief would be expected between the uplifted southern Appalachians and the adjacent Atlantic and Gulf Coastal Plains (potentially on the order of several thousand feet), no such drastic elevation differences would be expected between northern Peninsular Florida and the Keys even with regional tectonic tilting. The trans-

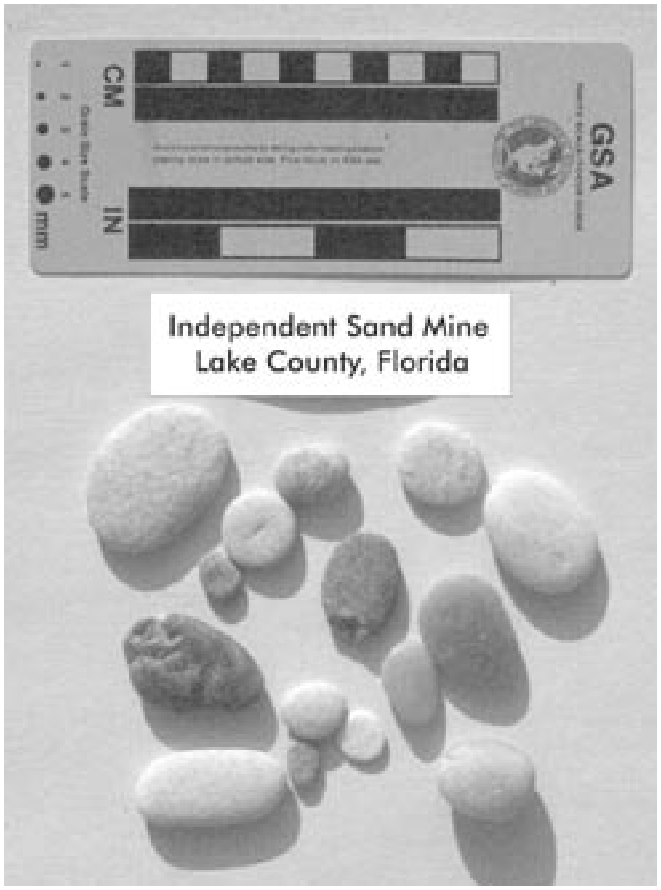

**Figure 3. Quartzite pebbles from the Independent Sand Mine in Lake County, Florida. Pickaxe number one in Figure 1 shows the general location in the Lake Wales Ridge area.**

port of coarse quartzite sediment averaging 1.5 inches (3.8 cm) in diameter within the hypothesized fluvial/deltaic uniformitarian setting does not appear probable. Alternatively, invoking the transport and concentration of the larger quartzite pebbles by longshore drift would probably only occur under highly energetic storm conditions. The energetic setting within the uniformitarian interpretative framework necessary to explain this lithostratigraphic blanket across the Florida Peninsula remains unresolved.

## Creation-Flood Framework

The Creation-Flood framework does not preclude the correlation of sediments from a source area near the modern day southern Appalachians, across the Atlantic and Gulf Coastal Plains, and even extending out on the Florida peninsula. However, this detailed work remains to be conducted. While uniformitarian geologists interpret the uplift and erosion of the southern Appalachians over the course of 465 Ma spanning three major periods of orogenic activ-

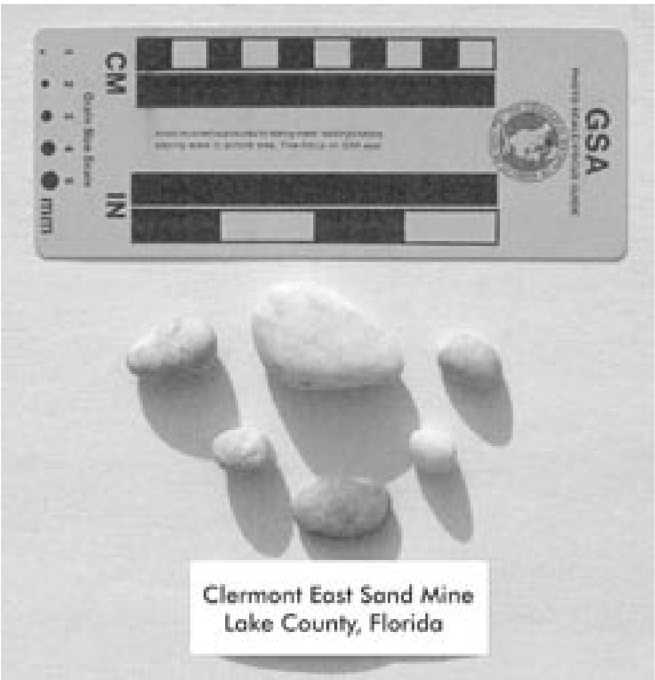

**Figure 4. Quartzite pebbles from the Clermont East Sand Mine in Lake County, Florida. Pickaxe number 1 in Figure 1 shows the general location in the Lake Wales Ridge area.**

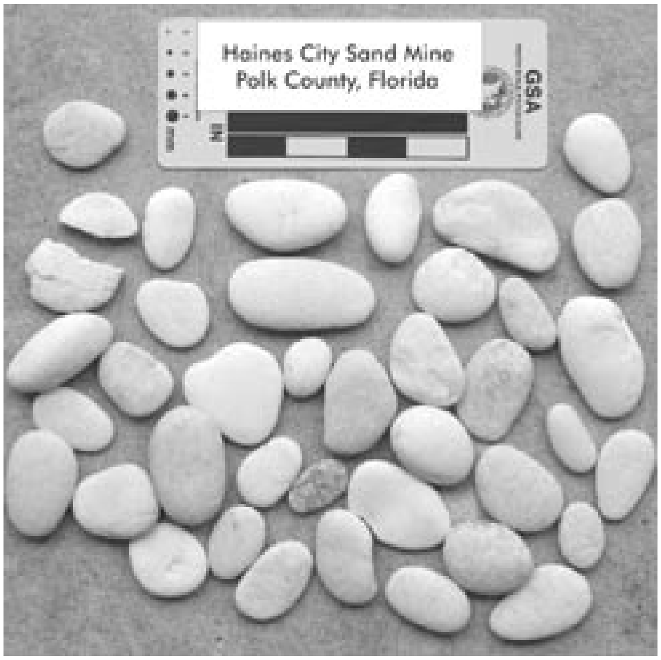

**Figure 5. Quartzite pebbles from Haines City Mine on the eastern flank of the Lake Wales Ridge in Polk County, Florida. Pickaxe number two in Figure 1 shows the general location in the Lake Wales Ridge area.**

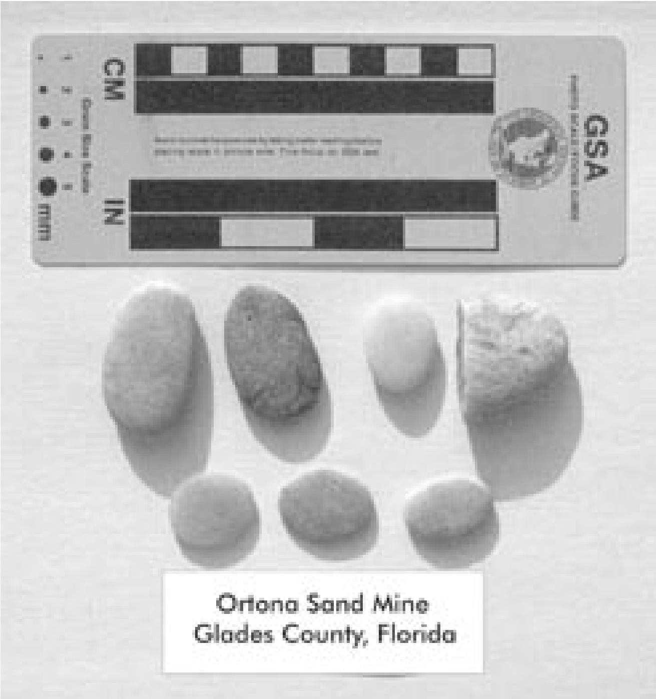

**Figure 6. Quartzite pebbles from the Ortona Sand Mine in Glades County, Florida. Pickaxe number three in Figure 1 shows the general location in the gray shaded area adjacent to Lake Okeechobee.**

ity (i.e., Taconic, Acadian, and Alleghenian), young-Earth creationists must operate within a much shorter period of time and with greater geologic energy (Froede, 1995, 1998; Reed, Froede, and Bennett, 1996; Reed, 2001).

The expectation of a higher than present sea-level position necessary to wash sediments from the southern Appalachian Mountains down to south Florida is not counter to the uniformitarian belief that sea level was higher during the Pliocene Epoch. Elevated Floodwater conditions easily correspond to the perceived uniformitarian aqueous conditions of this portion of the Pliocene. Our interpretative differences occur in both the magnitude of energy and time duration in which this lithostratigraphic unit was formed.

Within a Biblical framework, sediments found either at the surface or in the subsurface across the southeastern United States could be defined within several possible geologic intervals (i.e., Creation Week, Antediluvian, Flood Event, Ice Age, and Present Age Timeframes) [Froede, 1995, 1997, 1998]. However, the various major and minor orogenic periods would all likely correlate to the Flood Event Timeframe. Within this Creation/Flood framework, discussion is now limited to the siliciclastic sediments found along the Florida peninsula.

### Source Areas

Uniformitarian geologists invoke eroded Appalachian basement rocks as the source of the siliciclastic sediments found across the Florida peninsula. However, there are two possible source options: 1) the siliciclastics were created along the Florida peninsula in situ during the Creation Week or, 2) the quartz-rich sediments were eroded from the uplifted southern Appalachian Mountains, transported, and deposited as a result of the global Flood of Genesis. I believe that the latter option is the best interpretation within the Creation/Flood framework (Figure 7). The uplift of the southern Appalachians during the early stages of the Flood would have enhanced the erosion and removal of any overburden above the metamorphic and igneous basement (see Froede, 1998, chapter 8). Once exposed to the force of energetic floodwater, the igneous basement rocks would have rapidly eroded. The transport of this geologic material under the direction of Flood currents would have occurred somewhat radially off the area of uplift, with much of the material being transported southward across the Atlantic and Gulf Coastal Plains. The Suwannee Strait/Gulf Trough only temporarily impeded the spread of sediments southward. Once that channel was filled, the quartzite materials were transported across the coastal plain and down into northern Florida.

### Middle Flood Initiated Sediment Erosion, Transport, and Deposition

The southward-directed tilting of the Florida peninsula during the Middle Division of the Flood Event Timeframe provided a gradient and enhanced the progradation of siliciclastic sediments along the northern portion of the Florida peninsula. Areas of siliciclastic accumulation (e.g., Trail Ridge, Lake Wales Ridge, and other smaller topographic features) occurred as the sediments were transported further south, eventually reaching the South Florida Basin located beneath the northern Florida Keys. I believe that many of the tectonic features found along the peninsula were created as the siliciclastic sediments were being transported southward. These areas of uplift and downwarping served to confine and direct the quartz-rich materials as they spread southward to the northern Keys.

## Conclusion

The concept of a continuous sandy deposit containing quartz pebbles originating from the southern Appalachians and extending down the entire length of the Florida Peninsula appears to defy imagination. Uniformitarian and Creation/Flood geoscientists agree that vein quartz derived from basement rocks in the southern Appalachian Moun-

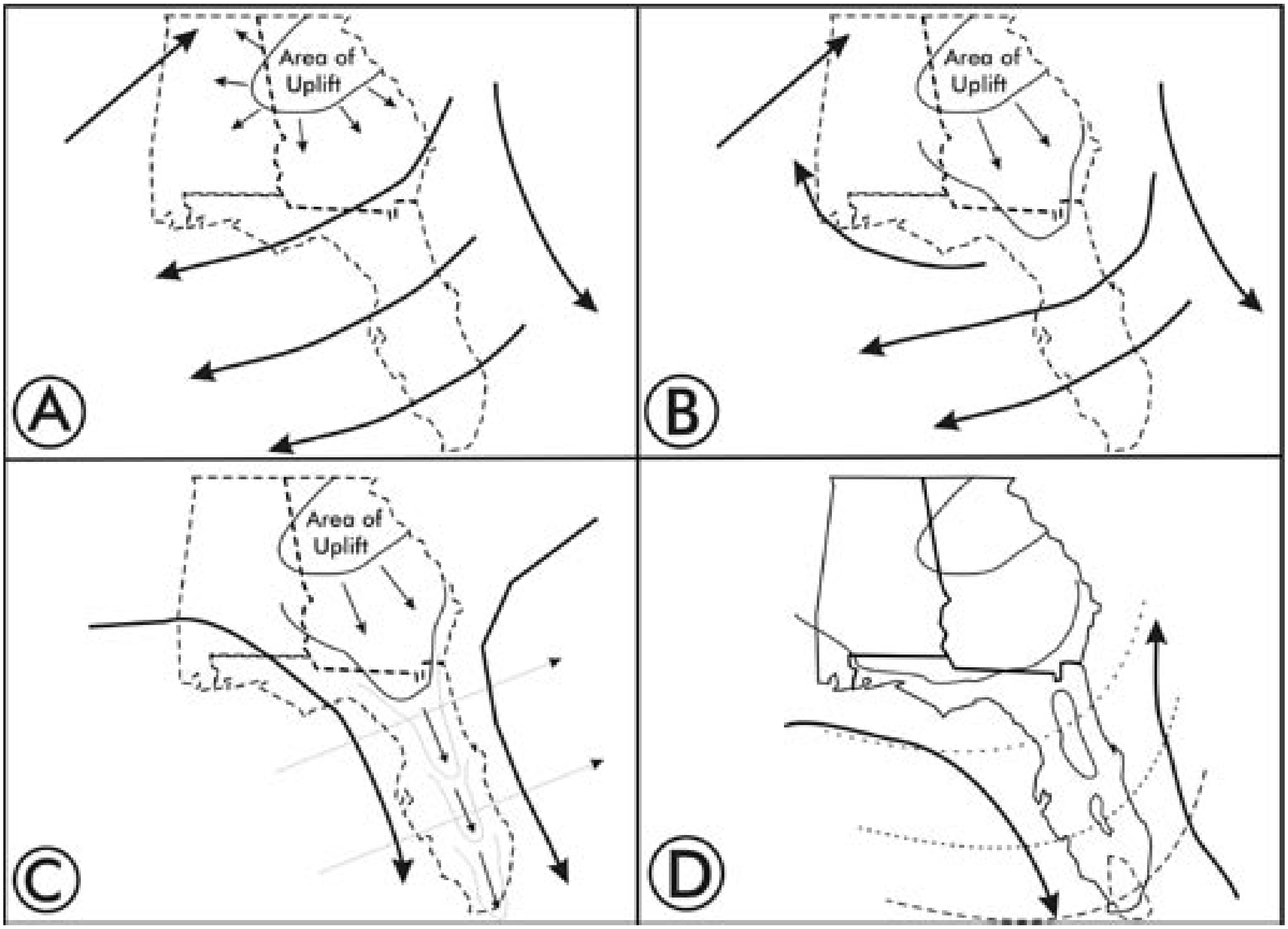

**Figure 7. Hypothesized Flood scenario showing; A—The Appalachian uplift which subjected the overlying geologic materials to erosion and transport, B—Floodwater currents still overtop the area of uplift but largely deflect and trend southward aiding the transport of sediments, C—With a combination of uplift and sea level decrease, the sediments are energetically transported southward across the Florida peninsula to the northern Florida Keys, D—The small dashed lines generally perpendicular to the Florida peninsula reflect the withdrawal of Floodwater and the erosion of the siliciclastic sediments that were exposed along the surface or near surface of the submerged peninsula. The dash-outlined lobe in south Florida represents the quartz-rich sediments that were later covered by carbonate material as the Floodwater withdrawal rate slowed and coral reefs were established across this portion of the State.**

tains is the source of this siliciclastic sediment. However, significant differences occur in the timing and manner in which these deposits were formed.

Uniformitarian geoscientists generally recognize these coarse-grained siliciclastic sediments as one lithostratigraphic unit of equal age (i.e., Pliocene). The volume and areal extent of the quartz-rich sediments that stretch from the southern Appalachians to the northern Florida Keys appears to require greater energetic conditions than might be expected or allowed within the naturalist framework. Factors necessary to defend this interpretation (e.g., differences in topographic relief, possible tectonism, water current velocity, and sedimentary setting) have not been detailed due to the apparent limitations of the various depositional models within the uniformitarian framework.

Young-Earth creationists would propose that the nature, volume, and areal extent of the siliciclastic sediments reflect conditions that could only be expected in association with the global Flood of Genesis. The sourcing of the siliciclastic sediments, their erosion and transport across the Atlantic and Gulf Coastal Plains and down the Florida Peninsula, along with the tectonism necessary to form this lithostratigraphic unit were all accomplished during the highly energetic Middle Flood Event Timeframe. The eventual reduction in geologic energy probably coupled with the deepening of the oceanic basins provided the slow withdrawal of Floodwater from the peninsula. This allowed carbonate deposition to occur across the still submerged southern portion of the Florida Peninsula and resulted in the eventual establishment of the Florida Keys Coral Reef Tract (Froede, 1999).

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*CRSQ: Creation Research Society Quarterly*

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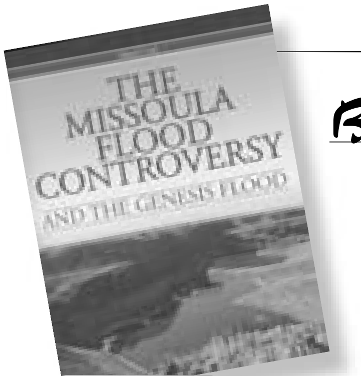

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# Book Review

## *The Missoula Flood Controversy and the Genesis Flood*
## by Michael Oard

**Creation Research Society Books, Chino Valley, AZ, 2004,**
**133 pages, $19.00.**

This well-illustrated monograph deals with an ice age flood of mammoth proportions. It is conjectured that the flow of melt water from glaciers was ponded behind an ice dam in northern Idaho forming a great lake named Lake Missoula. Lake deposits and remnant shore lines are found where the body of water once existed (pp. 30, 31).

Eventually the dam was breached and water roared out of the lake affecting parts of Montana, Idaho, Washington and Oregon. It is estimated (p. 34) that the maximum height of the flood water was about 400 ft. above the present location of Spokane, Washington with a discharge rate of approximately 600 million ft$^3$/sec. Some of the evidences of this flood include giant ripple marks, massive eddy gravel bars, scablands, coulees, and large exotic boulders transported by moving water well away from their source.

The first geologist to publicly present the evidence for such a flood was J Harland Bretz. Through the years after publishing his findings, he suffered considerable persecution from his fellow geologists for proposing such a catastrophic event even though he believed in uniformitarianism. Other geologists later offered different hypotheses to avoid the taint of catastrophism. Oard chronicles these various models and their refutation.

The possibility of many multiple local floods occurring rather than one single flood, evidenced by rhythmites in the region (pp. 38–48), is examined and rejected by the author (pp. 49–57). The existence of other ice age lakes is considered along with the possibility that these ponded waters could have breached their postulated ice dams causing other local floods as well as the likelihood of subglacial floods (pp. 59–67).

Chapter 7 is entitled "The Largest Flood of All—The Genesis Flood." Evidence for that worldwide catastrophe is given, particularly the enormous erosion that occurred as water flowed from the continents with major emphasis on the topography of the western United States. The author defends the young earth position (Ch. 8) and the idea of a single post-Flood ice age as opposed to so-called multiple ice ages. Brief comparison of the Genesis Flood and the Lake Missoula flood is given in Chapter 9. Oard notes that uniformitarian theories cannot explain the geomorphology of the earth whereas employing events in the Flood, especially the latter stage, makes more sense in discussing the origin of landforms.

The monograph contains a glossary and an extensive bibliography of creationist and uniformitarian literature. The content of the book is easily understood and is worthwhile reading.

Emmett L. Williams

# The Fiery Flying Serpent

**David Woetzel***

## Abstract

**Over the years Biblical scholars have speculated about the nature of the creature described in the Authorized Version as "the fiery flying serpent." The nexus of modern archaeological discoveries, ancient historical accounts, and recent cryptozoological research provides new insights into the identification and characteristics of this creature. Moreover, interviews and personal observations from a 2004 expedition that I led to Papua New Guinea convinced me that a fiery flying serpent still survives on a remote island there.**

## The Biblical Texts Reviewed

"The burden of the beasts of the south: into the land of trouble and anguish, from whence come the young and old lion, the viper and fiery flying serpent" (Isaiah 30:6). [Note: all Scripture citations are KJV.]

In this verse the Bible mentions an intriguing creature: the fiery flying serpent. The Hebrew words are *m'opheph* (translated flying) and *saraph* (translated fiery snake). It is here distinguished from the viper. Moreover, Isaiah 14:29 states: "Rejoice not thou, whole Palestina, because the rod of him that smote thee is broken: for out of the serpent's root shall come forth a cockatrice, and his fruit shall be a fiery flying serpent." Here the same animal is listed in a progression of animals as distinct from the serpent and the cockatrice. What exactly is this ancient flying creature referenced by the prophet Isaiah?

Creationists over the years have suggested that this flying reptilian creature was a living pterosaur, still known in the region of Palestine at the time of Isaiah's prophecy (see, for example, Ham, 1999, p. 45). Bible commentators have differed in their interpretation of these passages. For example, E.J. Young writes of Isaiah 14:29: "From one snake will come a poisonous serpent, and that poisonous serpent will produce another that is burning and flying" (Young, 1983, p. 451). He holds that Isaiah 30:6 references a real winged serpent and cites Herodotus 11.75, iii.109, and Ammianus Marcellinus xxii.15 (Young, p. 341). Motyer seems to side with the minority NIV translation "darting venomous serpent" but mentions "fiery flying one" as an alternate translation (Motyer, 1993, p. 148). The NAS renders this creature "flying serpent." The Septuagint translation of Isaiah 14:29 is *ofei petamenoi*, which are clearly words for a flying reptile with no variants. From a more liberal scholarship perspective, the authors of the Revised Standard Version translate it "fiery flying serpent." The BDB lexicon authors also render the creature "a flying serpent or *dragon*," but go on to suggest that it had its origin in the Egyptian Serref and was "mythically conceived with serpent's bodies (serpent deities)" (Brown, 2001, p. 977).

Oswalt's (1986) monumental commentary offers the most thorough discussion of this passage that I found, attempting to identify what each of the serpentine creatures in Isaiah 14:29 represent. One possible identification is the Assyrian monarchs, a view rejected by Motyer because of dating discrepancies (Motyer, 1993). But Oswalt (1986) then details how the "older commentators interpreted the staff as being a reference to the Jewish nation or the Davidic monarchy, both of which were in considerable disarray by the time of Ahaz' death and both of which had caused the Philistines great grief. In this view Hezekiah is the adder and the Messiah is the flying serpent" (p. 977).

It should be noted that some commentators have held that the flying serpent is merely a snake that springs from the high branches of a tree and then glides through the air

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* David Woetzel, B.S., 105 Wood Hill Road,
Bow, NH 03304, Email: dwoetzel@juno.com
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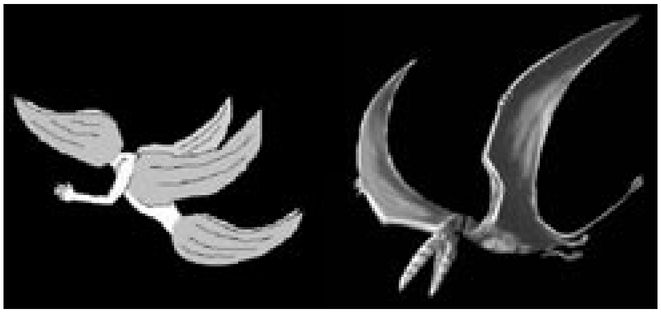

**Figure 1 and Figure 2. Comparing the profile of a pterosaur with a seraph with wings folded over the head and abdomen. (Figure 2 is after original artwork by Dan Leitha.)**

like a flying squirrel (Wiseman, 1972). These flying snakes are mentioned by the eighteenth-century author Niebuhr as he traveled through Arabia (Niebuhr, 1792) and are still known today through Southeast Asia (Roach, 2002). Modern species are not particularly venomous, nor are they remarkably bright in coloration, so it is unclear why they would have been called "fiery" if this were the actual creature referenced. From a creationist perspective, it would seem that the pterosaur interpretation of these verses is at least as reasonable as the alternatives.

The same Hebrew word *saraph* is employed by the prophet Isaiah to describe the heavenly beings that fly around God's throne (Isaiah 6) and comes from a root that means "to burn" or "to kindle." Could it be that these attendants appeared to be like the fiery flying serpents that Isaiah knew in his day? It would be akin to John's recording of them in Revelation 4:6–8, where he likens these six-winged seraphim to specific animals. But unlike John, Isaiah did not see their faces in his vision; for they covered their heads with two wings and their legs with two wings, leaving only their hands (v. 6) and trunks uncovered. Perhaps they looked to him like svelte, glowing winged serpents (Figures 1 and 2). While some commentators believe that the seraphim have nothing in common with the serpents except the name (Motyer, 1993) most hold that there was some visual similarity.

Young (1983) writes:

> The word "seraph" is also employed of poisonous serpents (Num. 21:4ff.) which could fly (cf. Isa. 14:29; 30:6).… Those who favor the identification with serpents appeal to the statements of the classical writers; e.g. Herodotus (2:74) mentions holy serpents found at the temple of Jupiter at Thebes.… The seraphim are personal, spiritual beings, for they have faces, feet and hands, they employ human speech and understand moral concepts. The only relation which they sustain with the fiery serpents is that they have wings and are burning creatures (pp. 239–240).

Oswalt (1986) again provides a very thorough analysis, affirming alternate interpretations:

> Since they are called seraphim…a term elsewhere applied to serpents (Num. 21:16; Isa. 14:29, 30:6), some scholars believe that they were serpentine or dragonlike in appearance. However, the chief meaning of the term may be "fiery" (Num. 21:6), so that the name of the snake is merely derivative (referring to their bite), and the use of the term for the ministering beings would indicate they were "fiery ones." There is no reason to dismiss automatically either of these possibilities. Composite figures are known from all over the ancient Near East, and while none is so far attested in Israel, it is possible that use was made of them. Such mysterious, awesome beings would be quite appropriate in this sort of vision. On the other hand, fire is everywhere associated with God's holiness…so that it would be entirely appropriate for those who declare that holiness (v .3) to be "fiery" in their appearance (pp. 178–179).

Other expositors have taken a much stronger position on the dragon-like identification of the seraphim (e.g., Joines, 1976).

The only other circumstance in which this Hebrew word *saraph* is used in scripture is the famous event involving snakes in Numbers 21 (and recounted in Deuteronomy 8:15). The children of Israel had been forced to travel south towards the Gulf of Aqaba (into what is modern Saudi Arabia) because the nation of Edom had refused them passage. Lacking water and increasingly contemptuous of the manna, these murmuring Israelites faced God's judgment.

Numbers 21:6 states: "And the Lord sent fiery serpents [*saraphim naphashim*] among the people, and they bit the people; and much people of Israel died." The traditional interpretation of attacking venomous snakes (Edersheim, 1995, p. 133) invites a couple of objections. First, the biblical account indicates that many of the Jews died (probably many thousands). Obviously, God could miraculously do whatever He wishes, but one has a hard time envisioning the people being pursued across the wilderness by slithering poisonous snakes. Common snakes should have easily been avoided.

Second, we note verse 8: "And the Lord said unto Moses, Make thee a fiery serpent, and set it upon a pole: and it shall come to pass, that every one that is bitten, when he looketh upon it, shall live." This passage is a beautiful picture of how those bitten by the Satanic curse of sin cannot heal themselves from sure death; but they need only look in faith to Christ's work on the cross to live. Indeed, Christ applied this passage to himself: "And as Moses lifted up the serpent in the wilderness, even so must the Son of man be lifted up: That whosoever believeth in him should not perish, but have eternal life" (John 3:14–15). Yet it seems strange to employ the cursed snake (a symbol of Satan from Genesis 3:1 to Revelation 20:2) as the parallel of Christ.

It has been suggested by certain Bible scholars over the years that that the creature referenced here may be the flying serpents (c.f., comments on Numbers 21 in Gill, 1766). Matthew Henry, in his famous *Commentary on the Whole Bible* (1992), writes:

> They had impudently flown in the face of God himself, and the poison of asps was under their lips, and now these fiery serpents (which, it should seem, were flying serpents, Isaiah 14:29) flew in their faces and poisoned them (p. 520).

So while the Hebrew word *naphash* is clearly the word for common snakes, these commentators have concluded that the compound word *saraphim naphashim* should be translated "fiery flying serpents." It would appear that the saraph was a reptilian, snake-like creature, distinguished from common snakes predominantly by their ability to fly. While I cannot be certain that the saraph is not some species unknown to us in either fossilized or extant animals, I believe that the pterosaur identification is most reasonable. Indeed this interpretation seems to fit the context quite well. These flying snakes, or pterosaurs, could have attacked and overcome the Israelites from the air. They would have formed an ideal picture of the Messiah, in that Christ was made like us (indeed made sin for us according to II Corinthians 5:21), but he was still fundamentally different (divine). The winged serpent incorporates simultaneously the appearance of the snake and the lofty ability of flight in a unique animal. Moreover, the outstretched pterosaur on the pole would have formed a perfect cross!

It is likely that the New Testament author also referenced these fiery winged seraphim when writing to the Hebrews: "Who maketh his angels spirits, and his ministers a flame of fire" (Hebrews 1:7). The emphasis then, it would appear, is on the saraph's bright, fiery nature.

## Historical & Archaeological Evidence

There is some historical and archaeological evidence in support of a pterosaur interpretation of these Old Testament passages. Note that the nation of Philistia referenced in Isaiah 30 is geographically intermediate between the land of Israel and Egypt. This is the same region from which the ancient reports of pterosaurs come. Various historians told of small flying reptiles in Arabia and Egypt, recounted the virility of their poisons and described their predator, the ibis bird (Epstein, 1973, p. 43). The ancient authors Aristotle, Philae, Aelianus, Ammianus, Mela, Solinus, anonymous fourth-century Coptic monks, the thirteenth-century Armenian historian Matthew of Edessa, Solinus, Cicero, Aristotle, and Philae all reference flying serpents (Goertzen, 1998).

The well-respected Greek researcher Herodotus (1850) wrote:

> There is a place in Arabia, situated very near the city of Buto, to which I went, on hearing of some winged serpents; and when I arrived there, I saw bones and spines of serpents, in such quantities as it would be impossible to describe. The form of the serpent is like that of the water-snake; but he has wings without feathers, and as like as possible to the wings of a bat (pp. 75–76).

In his third volume Herodotus goes on to tell how these animals could sometimes be found in the Arabian spice groves. He describes their size, coloration, and reproduction. It seems flying serpents were infamous for hanging in frankincense trees. When workers wanted to gather the tree's incense, they would employ putrid smoke to drive the flying reptiles away (see Herodotus, 1850, pp.107–108).

Josephus' account (Josephus, 1960) is particularly lucid. He tells of Moses, while still living in Pharaoh's court, leading an Egyptian army against Nubia:

> …but Moses prevented the enemies, and took and led his army before those enemies were apprised of his attacking them; for he did not march by the river, but by land, where he gave a wonderful demonstration of his sagacity; for when the ground was difficult to be passed over, because of the multitude of serpents, (which it produces in vast numbers, and indeed, is singular in some of those productions, which other countries do not breed, and yet such as are worse than others in power and mischief, and an unusual fierceness of sight, some of which ascend out of the ground unseen, and also fly in the air, and so come upon men at unawares, and do them a mischief,) Moses invented a wonderful stratagem to preserve the army safe, and without hurt; for he made baskets, like unto arks, of sedge, and filled them with ibes, and carried them along with them; which animal is the greatest enemy to serpents imaginable, for they fly from them when they come near them; and as they fly they are caught and devoured by them, as if it were done by the harts (p.58).

The Greek word used by Josephus for "snake" is the same one employed by Christ in John 3 (and also by Paul in I Corinthians 10:9) to describe the attacking serpents in the wilderness (*ophis* or *ophesi* in its masculine, dative, plural form). It is also the same as the Septuagint version of the wilderness account. This is the common Greek word for snake, so perhaps there was no unique Greek word for *pterosaur* like the Hebrew “saraph.” Instead the Greek authors fell back on the phrase “flying serpent” as the way to distinguish the winged reptilian creature, just like the KJV translators did in English.

Pliny (1855) echoes the words of Josephus:

> The Egyptians also invoke their ibis against the incursions of serpents; and the people of Elis, their god Myiagros, when the vast multitudes of flies are bringing pestilence among them….” (p. 933)

The Assyrian monarch Esarhaddon recounts how he marched south into the desert “where serpents and scorpions cover the plain like ants” (Luckenbill, 1989, p.556) and he recorded seeing yellow serpents that could fly as he marched to fight against Tirhaka, king of Egypt and Nubia (Borger, 1956, p. 90).

After the incident in the wilderness of Arabia recorded in Numbers 21, the artifact of the saraph on the pole was preserved for centuries. Unfortunately, it later became an idolatrous symbol of worship, called Nehushtan. Hezekiah is recorded to have “removed the high places, and brake the images, and cut down the groves, and brake in pieces the brazen serpent that Moses had made: for unto those days the children of Israel did burn incense to it: and he called it Nehushtan” (II Kings 18:4).

Archaeological artifacts from this same time period provide evidence of pterosaur worship. A plate found with Sennacherib’s booty at Calah (Nimrud) depicts a winged serpent (Figure 3). A *lmlk* seal, universally thought to date from Hezekiah’s reign and found in many excavations of the cities of Judah, was found in the same area at the Assyrian palace as well as other bronzes with Hebrew inscriptions. Therefore it appears likely that the plate is of Hebrew or Phoenician origin (Goertzen, 1998). Particularly fascinating are the spikes along the flying serpent’s tail and the ribbed wings.

Further indication of the religious significance of the pterosaur symbol comes from the multiple flying serpent seals recovered from Judah’s Lachish region. Shown above is an artifact found near Samaria with a Hebrew inscription of the “priest of Dor” on it (Figure 4). Note again the ribbed wings and long tail. Perhaps such idolatrous flying serpent worship was part of the reason that God allowed the fenced cities (including Lachish) to fall to Assyria, while miraculously preserving King Hezekiah and Jerusalem (II Kings 18:13–14).

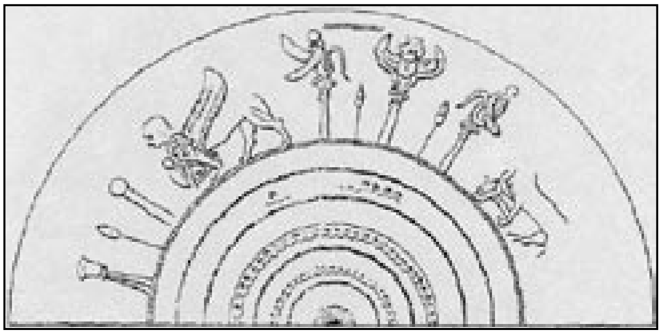

**Figure 3. The Sennacherib Plate with depictions that appear to be pterosaurs on a pole. From Barnett (1967).**

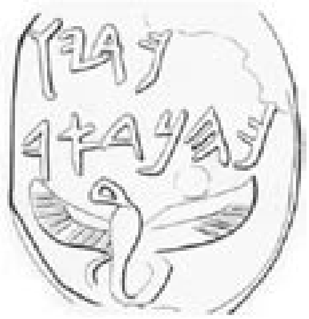

**Figure 4. The seal with the inscription “Priest of Dor” and the pterosaur-like depiction. From Keel (1977).**

The Jewish Encyclopedia states:

> The seraphim are frequently mentioned in the Book of Enoch (xx. 7, lxi. 10, lxxi. 7), where they are designated as δράκονες (‘serpents’), and are always mentioned, in conjunction with the cherubim, as the heavenly creatures standing nearest to God. …Some authorities hold that the seraphim had their origin in the Egyptian ‘seref,’ a composite, winged creature…” (Hirsch and Benzinger, 2002, p. 201).

Since the Israelites had lived with Egyptians for so many years, it is not surprising that they would have adopted their word. Indeed, many compelling depictions of the pterosaur, including seal artifacts, King Tut’s throne, and sarcophagus art, were found in Egypt (e.g., http://www.genesispark.com/genpark/ancient/ancient.htm).

Even two hieroglyphic hymns (used for the coronation of the Pharaoh) found within the pyramids mention the “seref:”

> The doors of the horizon are opened, their bolts
> are slipped.
> He comes to thee, O Red Crown; he comes to thee,
> O Fiery One (seref).
> He comes to you, O Great One; he comes to you,
> O Magician.
> O Red Crown, O Inu, O Great One,
> O Magician, O Fiery Snake! (seref)
> Let there be terror of me like the terror of thee.
> Let there be fear of me like the fear of thee.
> (Frankfort, 1948, pp. 107–108)

The first-century author Silius Italica (1934) wrote of “a serpent, glittering with rough spots of gold, was seen to glide athwart the sky between the clouds, tracing a furrow of fire in the heavens [considered a portent]” (p. 335). The

Roman poet Lucanus (1896), who accurately described many reptiles, wrote of "the chelydrus, whose track smokes as it glides along" (pp. 558–559).

Historical references to pterosaurs have been made in more recent times as well. Four of the leading naturalists of Medieval Europe (Ulysses Aldrovandi of Italy; Conrad Gesner of Switzerland; Edward Topsell of England; and Pierre Belon of France) reference flying serpents. An example from the Middle Ages is the compelling account of bright flying serpents described by Marie Trevelyan (1909):

> The woods around Penllyne Castle, Glamorgan, had the reputation of being frequented by winged serpents, and these were the terror of old and young alike. An aged inhabitant of Penllyne, who died a few years ago, said that in his boyhood the winged serpents were described as very beautiful. They were coiled when in repose, and "looked as though they were covered with jewels of all sorts. Some of them had crests sparkling with all the colours of the rainbow." When disturbed, they glided swiftly, "sparkling all over," to their hiding places. When angry, they "flew over people's heads, with outspread wings bright and sometimes with eyes, too, like the feathers in a peacock's tail." He said it was "no old story," invented to "frighten children," but a real fact. His father and uncles had killed some of them, for they were "as bad as foxes for poultry." This old man attributed the extinction of winged serpents to the fact that they were "terrors in the farmyards and coverts." An old woman, whose parents in her early childhood took her to visit Penmark Place, Glamorgan, said she often heard the people talking about the ravages of the winged serpents in that neighbourhood.

European reports of flying serpents living in Egypt persist through the 1600's. The Italian naturalist Prosper Alpin (1979, pp. 407–409) wrote a fascinating natural history of Egypt in the 1580's. He describes their crest, a small piece of skin on the head, their tail being "thick as a finger," their length being "as long as a palm branch," and their leaf-shaped tail. All is precisely like modern fossil reconstructions. Amongst several such depictions from that era, a French wooden image (Figure 5) dating from the sixteenth century, displays remarkable features of a pterosaur.

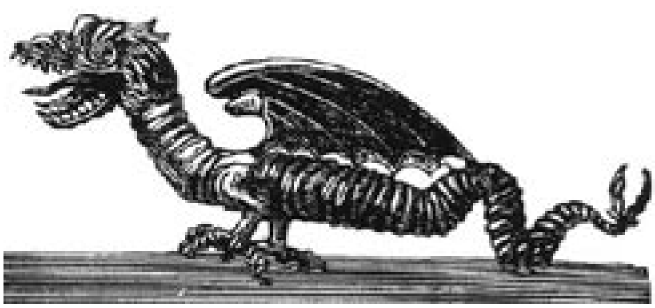

**Figure 5. French woodcarving that appears to depict a pterosaur. From Charbonneau-Lassay (1940).**

The prolific seventeenth-century writer Athanasius Kircher's record tells how the nobleman, Christopher Schorerum, prefect of the entire territory:

> …wrote a true history summarizing there all, for by that way, he was able to confirm the truth of the things experienced, and indeed the things truly seen by the eye, written in his own words: On a warm night in 1619, while contemplating the serenity of the heavens, I saw a shining dragon of great size in front of Mt. Pilatus, coming from the opposite side of the lake [or 'hollow'], a cave that is named Flue [Hogarth-near Lucerne] moving rapidly in an agitated way, seen flying across; It was of a large size, with a long tail, a long neck, a reptile's head, and ferocious gaping jaws. As it flew it was like iron struck in a forge when pressed together that scatters sparks. At first I thought it was a meteor from what I saw. But after I diligently observed it alone, I understood it was indeed a dragon from the motion of the limbs of the entire body. From the writings of a respected clergyman, in fact a dragon truly exists in nature it is amply established" (Kircher, 1664, pp. 179–180).

Other Medieval authors discussed flying creatures that "glowed at night" from Norway and the French Alps (Constable, 1984, p. 81). The classic work Beowulf even mentions flying dragons that emit fire (lines 2307–2336) and reptiles blasting fire at night (lines 2773–2783). Bill Cooper (1995) wrote:

> The last monster to be destroyed by Beowulf (and from which encounter Beowulf also died in the year AD 583) was a flying reptile which lived on a promontory overlooking the sea at Hronesness on the southern coast of Sweden…. Interestingly, the Saxons also described this creature as a ligdraca, or fire-dragon.

A dragon was supposed to have lived near Rome in December, 1691. According to the story, the animal inhabited a cave and terrorized the local population. After its demise, a sketch of the skeleton (Figure 6) survived in the possession of an Ingegniero Cornelio Meyer. It seems to be a credible pterosaur specimen. There is a clear indication of a head crest. Five digits are visible for each foot. The upper arm bone can be seen at the front of the wing as well as the hint of the prototagium (in front of the lighter colored upper arm of the near wing). The membrane wings are shown in front of the legs, on the vertebrae, matching the fossils. The femur is properly shown as a single bone. The tibia and fibula, the twin lower leg bones, are visible too. Some have suggested that it could be a fossil or faked composite, but it is much too accurate to be considered a

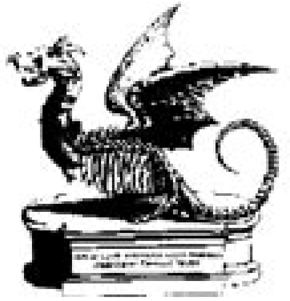

**Figure 6. Sketch of the skeleton of the dragon killed near Rome. From Goertzen (1998).**

fabrication. The survival of the skin suggests that it is not a fossil since it includes accurate wing features, a head crest, and reptilian ears.

Samuel Bochart (seventeenth-century writer) produced one of the most outstanding studies of biblical reptiles ever accomplished and maintained the existence of flying reptiles. Bochart describes an ancient Hebrew work *Porta Coeli* mentioning how "the flying saraph sets fire to the air, corrupting [or poisoning] all that is near it" (Bochart, 1663, p. 215). Many other accounts from the Middle Ages testify to the existence of glowing, flying reptilian creatures.

## Modern-Day Research

We have noted how the pterosaur interpretation fits well with the scriptural account and is supported by historical and archaeological evidence. There still remains the question of why a "fluttering" pterosaur would be called a *saraph* when the root of this word is "burning." Some scholars have speculated that this refers to their venomous bite. Others suggest that, like the brilliant seraphim around the throne, it references their luminosity. At this point cryptozoological research can perhaps add some insight into characteristics of pterosaurs.

Reports of extant pterosaurs come from around the world, including the Kongo-mato of Zambia and Kenya and the thunderbird of the western United States. (For further information on modern pterosaur reports, see www.genesispark.org.) But in my estimation the most promising region for finding a live pterosaur is Papua New Guinea (PNG). In 1944 Duane Hodgkinson was stationed northwest of Lae, near Finschaven, PNG as part of the Army cavalry. About noon one day in August he was walking down a trail through a clearing in the forest when he was startled by a crashing in the brush. As he watched a large bird-like creature ponderously rose from the ground, circled and flew away. Hodgkinson, a pilot, estimated the wingspan to be about 20 feet. He clearly recalls the dark-gray coloration, long serpentine neck, beak, and distinctive head crest. It reminded him of the cartoon, *Alley Oop*. Hodgkinson remarked to his associate that it resembled a pterosaur. His associate, an evolutionist, declared that this was not possible since all pterosaurs were extinct! (D. Hodgkinson, 2004, personal communication).

In 1987, Tyson Hughes, an English missionary, began an eighteen-month contract to assist the Moluccan tribespeople of Ceram Island, Indonesia to develop efficient farms. Tyson heard stories about a terrifying creature called the Orang-bati ("men with wings") that possesses enormous leathery wings like a bat and lives in the caves of Mount Kairatu, an extinct volcano situated in the center of the island. In Indonesia there are foxbats that grow up to 6 feet in wingspan. These bats are welcomed by the people because they knock ripe fruit out of the trees. The Orang-bati is quite clearly a different animal (B. Gibbons, 1999, pesonal communication).

As Western missionaries began to penetrate the deep jungles and remote islands of PNG, stories of a flying creature called the Ropen ("demon flyer") began to be reported. Described as a nocturnal creature, the Ropen possesses two leathery wings like a bat with "hands" on each wing, a long tail with a diamond-shaped flange on the end, and a prominent beak. The creature is thought to still inhabit the islands of New Britain and Umboi, located in the Bismarck Archipelago. The Ropen is said to have a taste for decaying flesh. Reports of harassment at native funeral gatherings at the government station of LabLab (on Umboi), and other attempts to disinter corpses suggests that the Ropen is a carrion animal. PNG natives will even put tin roofs over fresh graves to deter the creature.

Veteran missionary pilot Jim Blume tells of numerous credible encounters that New Guinea natives (about 70 eyewitness and 150 secondhand reports) conveyed to him over the last thirty years. These reports regarding the Ropen cover a wide geographic range: 150 miles southeast of his Wau mission station down the coastline to Popondetta and as much as 250 miles north up the coast to Wewak (J. Blume, 2000, personal communication). However, long-time missionaries in Kavieng, at the northern tip of PNG, and those working in the Eastern Highlands province are not aware of this animal (K. Crossman, 2003, personal communication). But there continue to be reports emanating from the island of Umboi. Wycliffe translators explained to me that the island population is linguistically divided between Kovia speakers (Papuan) which call the creature "Ropen," and the Austronesian speakers (Mbula and Mutu dialects) who refer to it as "Ndwaaza." The northernmost Mbula dialect uses still a different term, "Kundua." Both "Ndwaaz(a)" and "Kundua" mean "shooting star." In the western highlands there are stories from long ago about this creature, which they call the "Duos," which appears to be an abbreviation of "Ndwaaz(a)" (Bugenhagen, 2004, personal communication).

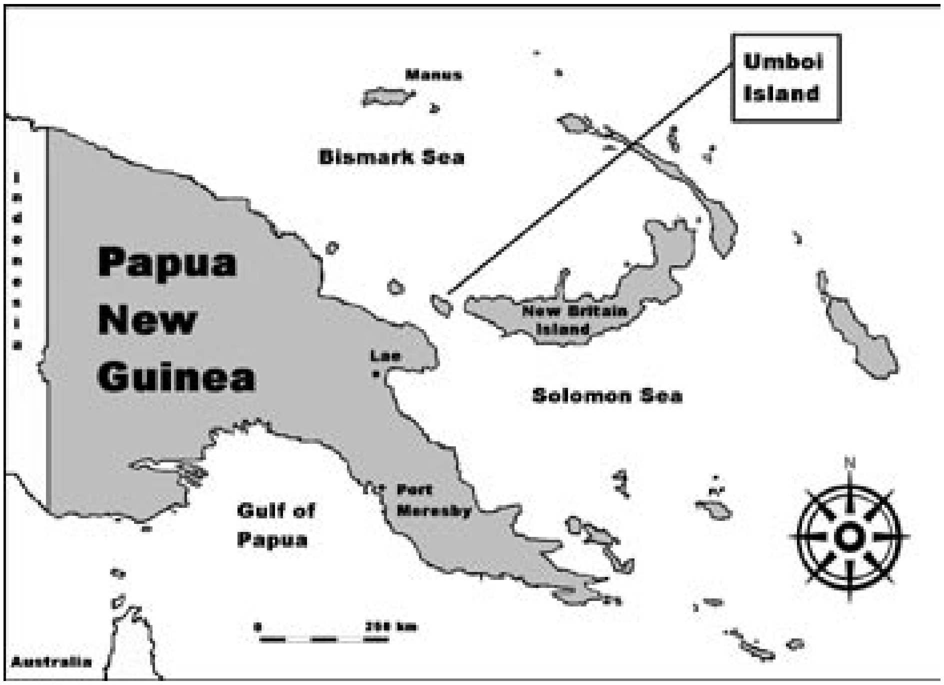

**Figure 7. Map of Papua New Guinea highlighting Siassi (or Umboi) Island, the Ropen research area. Modified from http://www.forestsmonitor.org/reports/highstakes/images/m3.gif.**

Although some superstition surrounds this remarkable creature, there are consistencies in the accounts from around the island regions (peoples that do not have any communication links) that lend credibility to the claims. The most remarkable part of the description is that the creature is reported to have a biolumiscent capability, like a firefly. Carl Baugh of the Creation Evidence Museum conducted two Ropen expeditions to PNG with Jim Blume, one to the island of Umboi, and another further north to the Manus region. While exploring around the Manus islands, it became clear to Blume and Baugh that the pterosaur-like creature reported in that region was a different species from those observed further south. It was smaller (about 3 ft. wingspan), tan in color (by native reports), and reddish in its glow. Coloration in the reports from Umboi, on the other hand, vary from glittering black to a very dark grey. The bioluminscence color is described as a white/bluish glow. Indeed, many who see the glowing creature fly past them describe it as a shimmering white light with a rainbow of colors being thrown off.

It seems that the Ropen possesses the ability to turn its internal light on and off at will. Also, reports suggest the presence of a secretion that drips behind when the underbelly glows. Reports suggest that this secretion is alkaline and burns the skin of those who come in contact with the creature. This brings to mind the ancient historian Aelian's words about the flying snakes:

> Megasthenes states that in India there are … snakes (ophies) with wings, and that their visitations occur not during the daytime but by night, and that they emit urine which at once produces a festering wound on any body on which it may happen to drop" (Aelianus, 1972, pp. 203–204).

Strabo (1967) concurs:

> …in some places there are serpents of two cubits in length, with membraneous wings like bats. They fly at night, and let fall drops of urine or sweat, which occasions the skin of persons who are not on their guard to putrefy." (pp. 97–98)

On one expedition to PNG, Blume and Baugh followed up on reports from a particular island in the Manus group that claimed these creatures were living in the caves dotting the island. While in a boat in the early evening they observed what appeared to be an oval-shaped luminescent flying object gliding from the hillside down along the bay. After observing the pulsing light-greenish light and looking through a monocular night scope for about 20 minutes they lost contact with the object. The next morning, Baugh snapped a picture of a strange clawed print on the muddy beach (C. Baugh, 1999, personal communication and Baugh, C. 1999. PNG Expedition Video II).

Could it be that a living pterosaur still exists today in PNG? Is this strange luminescence the reason that the ancient prophet refers to the flying serpent as "fiery"? I determined to further research these Ropen reports, particularly focusing on Umboi (or Siassi) island, with hopes of answering some of these questions.

## Trip to Papua New Guinea

On October 17, 2004, Garth Guessman of Los Angeles and I departed from the United States for a twenty-three-day expedition to research the Ropen of PNG (Figure 7). Upon landing on a small grass airstrip the southeast side of Umboi island, we hired a guide and engaged a small banana boat to take our team up the eastern coast. We stopped to refuel in the town of Kampalap and conducted some interviews of villagers. They were familiar with the Ropen and claimed that it lived in a cave on Mount Bel, though none could assure us that they had seen this haunt with their own eyes. They did, however, tell how the creature fishes in the reef off the coast. Approximately once a month it flies down to a large tree (at which point the glow slowly subsides) and, after making sure the coast is clear, swoops down to fish in the surf.

Further up the coast, at Aupwel village, natives knew less of the Ropen, only occasionally seeing it flying amongst the mountains. One notable exception was the secondhand report we received about a fisherman named William Gima. He claimed to have seen the Ropen "fishing." The creature would give off a five second flash over the ocean to attract fish and then drop to grasp them. He claimed to have seen the five-second flash within the prior few weeks. We shouldered our packs and hiked for the next few hours up into the mountainous village of Arot. This friendly community became the "home base" for us over the next couple weeks.

Our translator, Pastor Jacob Kepas, was becoming intrigued by the research we were undertaking and told us that he knew of the same type of creature in his home village as a child. His family lived near the mainland city of Wau in the Salamaua district of PNG. In his native Mali language the creature is known as "Seklobali," which means "[creature that] carries its bed." Although he could not give us any inkling how the animal had acquired this odd name, this was to become of interest to us later in our expedition.

From Arot village we clawed our way up Mt. Soul, a volcanic peak in the center of the island for a few nights of observation. Next we visited the nearby village of Mararamu. A villager there had seen the Ropen up close while fishing on a beach. He described his encounter to us in detail, pacing off a wingspan of approximately 13 feet (4 m) and describing its bat-like wings. Interestingly, he described how its tail was always held stiff and immobile, except at that point it attaches to the body. This is an important comment because scientists have noted from fossils that rhamphorynchoid pterosaurs, like Dimorphodon, have solid, bony membranes running down the length of their tails. These ossified supporting processes would have made it stiff and unbending except where the first several vertebrae attach the tail to the end of the spinal column, allowing the pterosaur to swing the tail back and forth like a rudder (e.g., Cranfield, 2001, p. 290).

On Wednesday, October 27, I volunteered to watch the camp so that our guides could attend a gospel service. That night about nine o'clock, I saw a spine-tingling sight—a glowing object passing low on the horizon from the direction of Mt. Barik and disappearing behind Mt. Tolou. It moved quickly—almost like a shooting star. But it was unlike any asteroid I had ever seen (and we saw plenty during our many all-night vigils). It was a large, yellowish glow approximately 20–25 percent the size of the full moon from a distance of about 1.9 miles (3 km). The light left no trail and it twinkled around the edges like an old-fashioned street light in the fog. The whole sighting lasted for only a few seconds, too brief to photograph it. I powered up the camcorder and night vision binoculars, but the light never reappeared. The next day we hiked up Mt. Tolou and spent five nights looking for the Ropen. Our vigils were to no avail, despite the excellent view and our even employing a dead wallaby as bait.

The last leg of our journey took us through the villages of the western coast and down to the government station of Bunsel. While at Bunsel we met some folks that explained to us their traditional belief that the Ropen feasts on a particular kind of large mollusk. We had heard reports from other villages about these clams (some of which are reported to litter Mount Bel). But the villagers were able to show us some of the shells, as big as 5 feet (1.5 m) in diameter! This intriguing piece of evidence suddenly recalled to our minds the odd Mali name for Ropen—creature that

**Figures 8 and 9. Pictures of the native woodcarvings of PNG depicting a Ropen on the shoulders of a medicine man. The front and side views show a winged reptilian creature.**

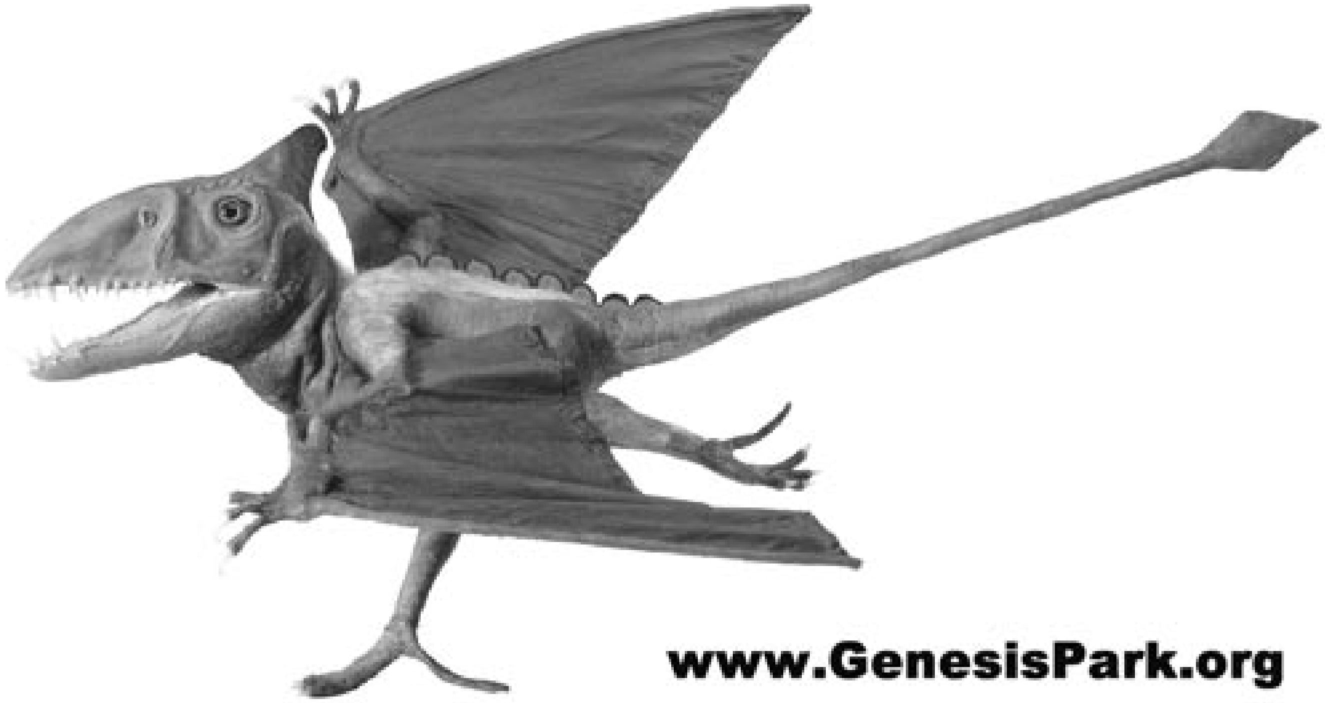

**Figure 10. Composite drawing of most likely Ropen characteristics gathered from eyewitness interviews. Modified from Clark and Lindsay (1995, p. 133).**

carries its bed. Indeed a low-flying pterosaur carrying a large mollusk up into its mountain lair would seem to be "carrying its bed!"

After returning to the mainland we had an extra day in Port Moresby which afforded us the opportunity to research some very interesting indigenous wood carvings on display (Figures 8 and 9). They depict a witch doctor with a reptilian form upon his shoulders. The creatures display a lizard-like ear, forked tongue, elongated snake-like neck, shallow beak, scaly membrane wings, dermal bumps running down their back, webbed feet, and a long tail (in one case being swallowed by a crocodilian). The statues display a "hairy" appearance, reminiscent of the Rhamphorynchus reconstruction at the Minneapolis Museum of Natural History.

The dozens of interviews conducted on this expedition provide important information on the Ropen. Witnesses were carefully questioned about the timing of sightings; details about the creature were carefully recorded; and the credibility of these villagers was tested. For example, black and white profiles were placed before them showing the silhouettes of eagles, vultures, bats, and various pterosaurs (including rhamphorynchoid and pterodactyloid varieties). We even included a secretary bird with a long feathered tail. Eye witnesses consistently picked out the pterosaurs. After carefully collating the dozens of interviews, Guessman and I came up with a composite of most likely characteristics possessed by the Ropen. These are reflected in the rendition shown in Figure 10. For example, most native reports (though not all) mention a broadening at the end of the tail. Similarly, a slight majority of witnesses recollect having seen a head crest. It is interesting that the eyewitness reports from Owangi Village and the carved statue both highlight the dermal humps (a feature unknown in the world of pterosaur paleontology but depicted on the Sennacherib plate).

One might inquire which of the species of known pterosaurs most fits with the reports coming from PNG. The native's suggestion of strong legs and powerful bipedal locomotion seem similar to the Dimorphodon. The short, heavy beak and face that were described also fit Dimorphodon or Anurognathus. Indeed the natives to whom we showed color pterosaur pictures identified Dimorphodon as the closest fit to the Ropen (despite the fact that it does not sport the Ropen's head crest). However, it is to be expected that variation and genetic drift over the centuries would cause the Ropen population to display some unique features, despite the fact that pterosaurs might comprise a single baramin (Biblical kind).

## Conclusion

It is my contention that the similarities in the several independent lines of evidence produce a powerful argument for a living pterosaur in Papua New Guinea. A missionary pilot's sighting, an American WWII veteran's testimony, a Highland PNG native's sculpture, dozens of eye witness reports from Umboi/Siassi and the Manus islands combine to make a strong case!

Follow-up research might best be focused on the smaller islands to the north of Umboi (Long Island & Sakar Island), as well as the rivers flowing out the south of Umboi. Also, more research should be done in the Manus chain further to the north where Jim Blume had his Ropen sighting. The best place on Umboi to achieve a nighttime sighting of the bioluminescent flight would probably be the "bald spot" where we were on Mount Tolou. It also seems to be an ideal place to try to bait the Ropen. But a detailed photo of this creature might well require finding a regular feeding, drinking or sleeping site. Various villagers on the island are now participating in this research. Perhaps the disposable cameras that we left with them might yet capture an historic photo.

The remarkable similarity in ancient and modern fiery flying serpent reports supports the plain interpretation of Genesis that men and pterosaurs have always coexisted. The reports of the bright appearance of pterosaurs from Isaiah, to the Egyptian hymn of the saraph, to the account from the Middle Ages to the reports of the Ropen are uncanny. It is very exciting to think that one of these magnificent creatures still survives.

Contemplating them should remind us of the one "Who being the brightness of his glory, and the express image of his person, and upholding all things by the word of his power, when he had by himself purged our sins, sat down on the right hand of the Majesty on high;" (Hebrews 1:3). What better picture could be given of the precious Messiah than the fiery flying serpent? Like false Nehushtan worshippers of old, evolutionists have appropriated the natural fascination with the terrible reptiles to propound their belief in naturalistic origins and billions of years of evolution. By God's grace we should strive to tear down this high place and point people instead to the great Creator who, like the serpent in the wilderness, was lifted up to die as our Redeemer.

## Acknowledgements

Special thanks to John Goertzen for his pioneering research on the fiery flying serpent in history and for reviewing an early draft of this paper.

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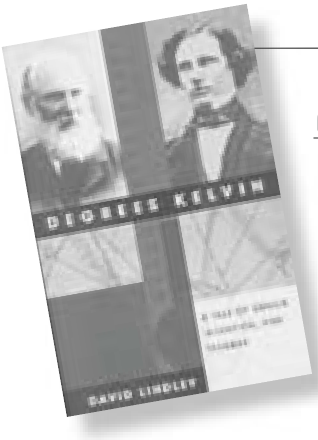
# Book Review

## *Degrees Kelvin* by David Lindley

**Joseph Henry Press, Washington D.C., 2004, 366 pages, $28.00.**



The book cover makes the lofty promise that this will become the definitive biography of William Thompson, known as Lord Kelvin. Kelvin (1824-1907) spent an amazing 67 years at England's Glasgow University, starting out as an eight-year-old sitting in his professor father's math classes. Father also read the Bible to his seven children (p. 26) but was consumed by pressures to have his family succeed academically. Dad's final incoherent hours of sickness were spent shouting out math expressions (p. 78).

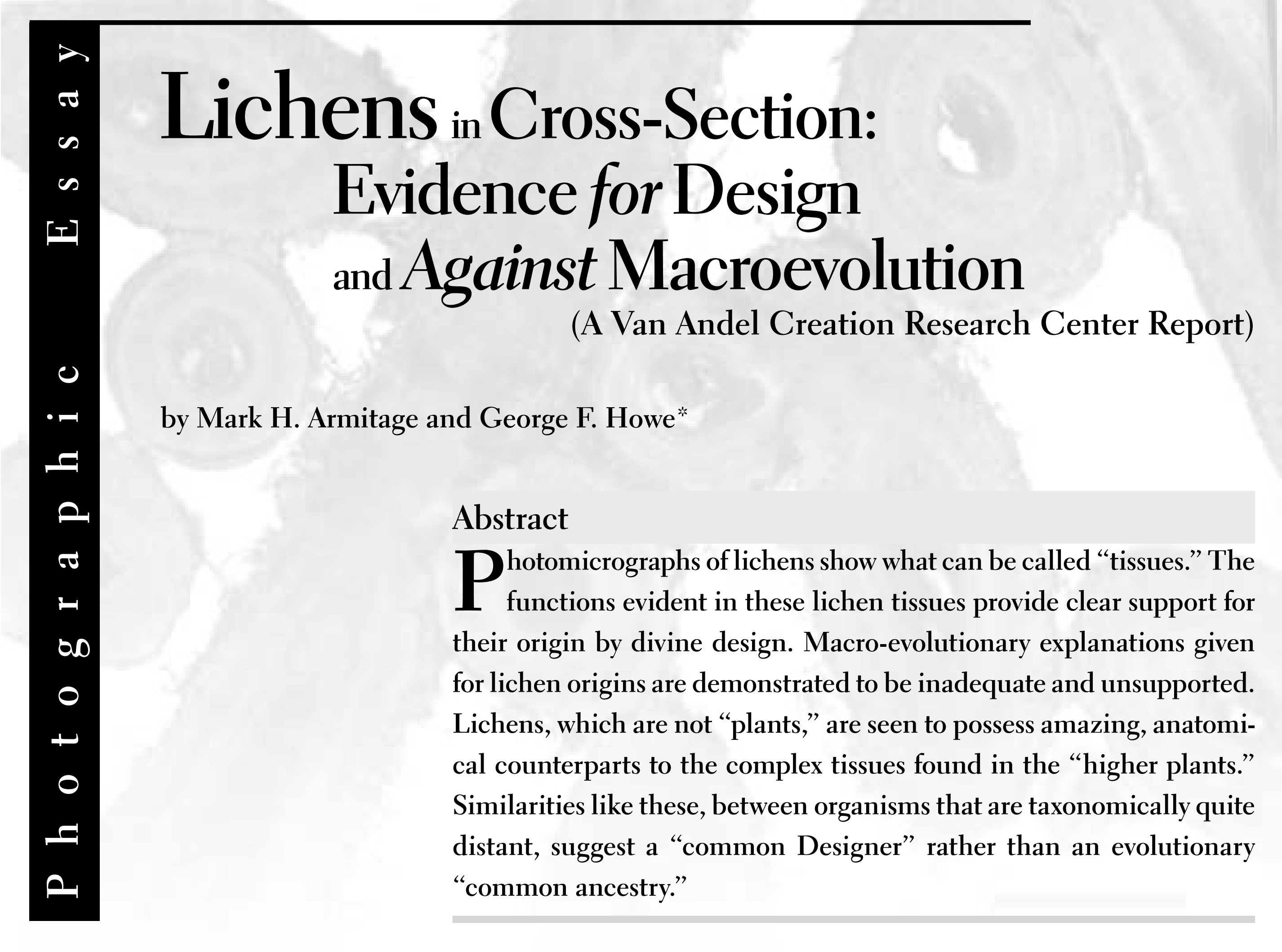
Kelvin had many successes in life. He was a top student at Glasgow in both physics theory and experimental research. His insight into electromagnetic theory led to the first clear transmissions with trans-Atlantic cables around 1858 (p.135). Kelvin made life-saving improvements in the mariner's compass in the 1870s (p. 236). These and several other advancements eventually led to William Thompson's honorable title, Lord Kelvin, granted by Queen Victoria in 1892.

Kelvin had close interactions with many science and math pioneers including Sadi Carnot, James Joule, Charles Fourier, James Clerk Maxwell, and George Stokes. Kelvin was not impressed with Darwinism and challenged the evolutionary assumptions of a long history of the earth. Kelvin saw a limited earth-age on the basis of rapid earth cooling. Darwin was greatly bothered by Kelvin and called him an "odius spectre" (p. 174). The author does not discuss the extent that biblical understanding influenced Kelvin's doubts about time and Darwinism. Kelvin did, however, reject evolution in any form, whether secular or theistic (p. 213).

Author Lindley, an astronomer, makes the usual statement that the discovery of radioactivity canceled Kelvin's assumption of a rapidly, passively cooling earth which was less than 100 million years old. Kelvin also is faulted for his awkward vortex theory of atoms (p. 293), a denial of nuclear transmutation, and his ill-advised support for direct current electrical transmission instead of alternating current. Despite the book title, the naming of the Kelvin temperature scale is not explained. Kelvin's name actually was honored with this unit of temperature in 1933.

Kelvin was a godly man who readily quoted scripture in his lectures (p. 91). He also gave 17 years of faithful care to his invalid wife until her passing in 1870. Kelvin qualifies as an outstanding creation scientist. His assumptions about earth age were a bit high but still 50 times smaller than the current geologic view. I suggest that Kelvin would have made a fine member of the Creation Research Society.

Don DeYoung
DBDeYoung@Grace.edu



Photographic Essay

# Lichens in Cross-Section: Evidence *for* Design and *Against* Macroevolution

## (A Van Andel Creation Research Center Report)

by Mark H. Armitage and George F. Howe*

## Abstract

**Photomicrographs of lichens show what can be called "tissues." The functions evident in these lichen tissues provide clear support for their origin by divine design. Macro-evolutionary explanations given for lichen origins are demonstrated to be inadequate and unsupported. Lichens, which are not "plants," are seen to possess amazing, anatomical counterparts to the complex tissues found in the "higher plants." Similarities like these, between organisms that are taxonomically quite distant, suggest a "common Designer" rather than an evolutionary "common ancestry."**

## Introduction

In Romans 1:20 the apostle Paul implied that many of God's attributes, such as His deity and His power, cannot be accessed directly by the human sense organs (Howe, 2003). Paul said it is possible to observe these otherwise invisible dimensions of deity by studying what God has made. The first of our four objectives is that readers understand more about the Creator by viewing the amazing anatomy of the lichens He has created.

Our second goal is to display the various lichen tissues in photomicrographs and to enumerate their functions. These tissues play numerous roles that enable lichens to grow north or south—on land or even in the sea. Although comparatively simple in structure, the functions of the tissues of lichens are nevertheless a tribute to design by their wise Creator.

A third objective is to discuss a few of the peculiar evolutionary comments made by otherwise intelligent lichenologists. Many of these scientists express their personal belief in the evolutionary origin of lichens, without mention of a creationist alternative. We are not criticizing or minimizing the experimental work of the lichenologists involved. Instead, we are demonstrating the vulnerability and futility of their underlying evolutionary origins speculations. A contribution that creation-minded workers can make is to carefully reassess the data in each field, including lichenology. Silence on our part concerning evolutionary blunders would be a disservice to science.

An additional objective is to draw attention to the fact that lichens frequently resemble plants from other biological "kingdoms." Such clear-cut similarities between organisms that are taxonomically "distant" from each other, support a "common Designer" rather than in a "common ancestry." When we describe startling resemblances, we do so to show the fact that

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* Mark H. Armitage, 587 Ventu Park Road #304, Thousand Oaks, CA 91320
George F. Howe, 24635 Apple Street, Newhall, CA 91321-2614

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such parallelisms would be unlikely from the vantage of macroevolution. Whenever evolutionists use the term "polyphylogeny" they are tacitly admitting that life had many independent starting points—not just one. Obvious anatomical counterparts in these widely separated groups support intelligent creation rather the neo-Darwinian evolution. This is a "biotic message" from the manufacturer, as ReMine (1993) noted. It would have been well for macroevolution to have produced a carefully designed component once. To ask that it originate similar systems two or more times in distant branches of the much-touted "evolutionary tree" is preposterous. The very idea would be dismissed without giving it a second thought, if evolutionism had not already become an item of reverent contemplation in the minds of so many people.

## Materials and Methods

Specimens of *Xanthoparmelia* sp., *Pleiopsidium chlorophana*., *Candelilaria* sp., and *Caloplaca* sp, were processed in a laboratory microwave (Pelco Model 3450 with model 3420 microwave load cooler, Ted Pella, Inc., Redding, CA), according to the protocol outlined by Giberson et al. (1997). Using the microwave procedure reduces processing time for plants and produces better preservation in tissues than the conventional method.

Tissues were fixed in 2.5% glutaraldehyde and postfixed in 2% osmium tetroxide within the laboratory microwave oven. Dehydration was carried out with graded steps of acetone using the microwave protocol described below. Infiltration and embedding were performed in a mixture of 1:1 Epon/Spurr's resin.

Places where there is higher than average microwave energy, called hot spots, exist within the microwave chamber. These were identified by using a neon bulb array, and were eliminated with water loads, which were replaced when the water became warm to the touch. A temperature probe was also used to restrict high temperatures at each step in the fixation, dehydration, infiltration, and polymerization processes (see Table 1 of Giberson et al., 1997). A diamond knife was used to produce silver-colored sections, which were collected on uncoated copper grids were stained in uranyl acetate and lead citrate. Specimens were viewed and photographed on an AEI 801Transmission Electron Microscope (TEM).

## Background Considerations about Lichens

### How Do Plant Tissues and Lichen Tissues Differ?

Tissues are clusters of cells that work together to fulfill one or more functions. Humans, animals, and "higher plants," like flowering plants, all possess tissues. Complex tissue structure is characteristically absent, however, from the mosses, liverworts, hornworts, fungi, and algae. A tissue in a flowering plant, such as a carrot plant, consists entirely of carrot cells and is thus monogenetic. Each cell in the carrot tissue possesses the same genes and chromosomes because they all have descended from one single cell—the carrot zygote.

Lichen tissues, however, do not develop from a single zygote. Lichens involve a very close symbiotic union between a fungus and an alga (Howe and Armitage, 2002; 2003). The alga, which cannot produce tissues alone, grows in close association with the lichen fungus, which is also unable to form tissues. But lichen tissues develop because fungus genes for producing them respond to signals from nearby lichen algal cells (Brodo et al., 2001). Lichen tissues arise by a complicated interplay between cells of these two very widely diverse genetic sources. Lichen tissues are organized cell clusters, which in both form and function "mimic higher plant tissues very closely" (Hale, 1976, p. 4).

Some workers call the lichen tissues "pseudo-tissues" (meaning "false") tissues because the lichen tissues exist in plants that are taxonomically "distant" from the vascular plants, which also yield true tissues. Tissues should simply be called "tissues" and not "pseudo-tissues," however, wherever they exist. In the creation view, no such distinctions between "true" and "false" tissues are necessary.

When the alga, called the "photobiont" by lichenologists, grows in union with the fungus (the "mycobiont") of a lichen, an entirely new "plant" arises—a "lichen." "When an alga and a fungus unite, they form a plant body entirely different from that formed by either component when grown alone" (Hale, 1961, p. 7). Tissues exist in lichens only because of the effect that the alga bears on the fungus. "Knowledge of the influence of the photobiont on the lichen morphogenesis is important, because only after the establishment of symbiosis is the characteristic thallus of a lichen developed" (Budel and Scheidegger, 1996, p. 38). "One fact is clear—the fungus cannot form a lichen thallus without the photobiont" (Ahmadjian and Jacobs, 1969, p. 52).

The lichen is really a "new plant," over and above the identity of either the fungus or the alga: "The lichen thallus is a vegetative plant body of **remarkable complexity** having little resemblance externally to either nonlichenized fungi or algae" (Hale, 1967, p. 1, emphasis added). Then Hale added a peculiar remark about origins: "The fungal component…has **succeeded** in establishing a symbiotic relationship with algae" [emphasis ours]. Hale attributed this "remarkable

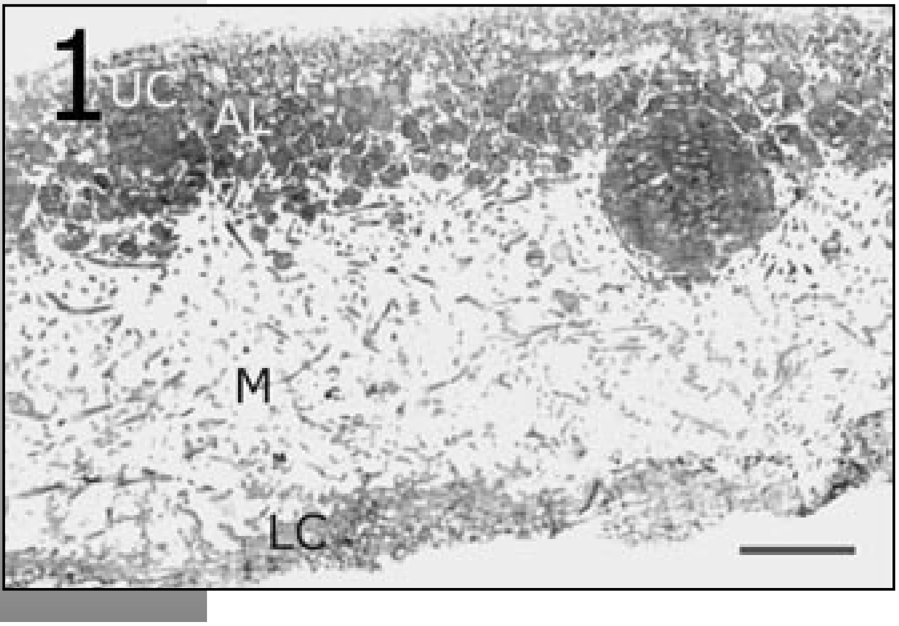
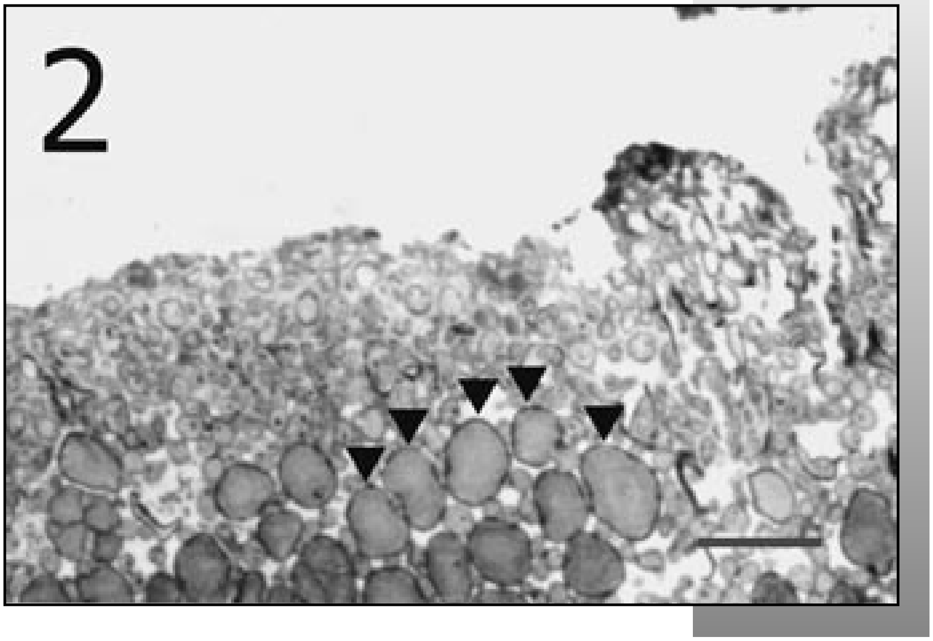


**Figure 1. A foliose lichen *Xanthoparmelia*, cross-section, 250X brightfield micrograph. Scale bar = 600 micrometers. The tissue layers discussed in this paper are all visible here: UC—upper cortex, AL—algal layer, M—Medulla, and LC—lower cortex. These tissues work together to control life-giving functions in the lichen. Foliose lichens like this one have a lower cortex, giving protection to the lower surface, which is exposed beneath at many locations. Design and function seen throughout the entire lichen support the creation origins view. We think the ball-shaped object at the right, moving upward from the medulla into the algal layer is an ascocarp—a fungus reproductive structure that produces ascospores.**

**Figure 2. A cross-section of the lichen *Caloplaca*, showing the cortex tissue above and the upper portion of the algal layer, 1000X brightfield micrograph. Scale bar = 250 micrometers. The same fungus that makes thick cell walls for strength and protection in the upper cortex (UC) makes much thinner cell walls in the algal layer (AL). Thin fungus cell walls are important in the algal layer because foods that are produced by photosynthesis in the algae must move through those thin fungus cell walls to enter and nourish the fungus cells. Each of the dark triangles points to a cell of the alga *Trebouxia*.**



complexity” in lichens to an ability of the lichen fungus to have ***succeeded*** in bringing about the symbiotic union. This is an example of “teleology”—the act of attributing purpose to the organism itself. Paul noted in Romans 1:20 that it is also bad theology to worship the creature rather than the Creator.

## What is Lichen Stratification?

A dermis layer is at the upper surface of some lichens. The dermis is thought to assist in preventing excessive water loss. Photographs of the lichen upper surface layer were previously published (Armitage and Howe, 2004). Scanning electron micrography (SEM) was used to examine many features of the lichen upper surface. Although relatively thin and small to the naked eye, lichen cross-sections demonstrate the complex anatomy of lichens, as seen in Figure 1. Beneath the dermis are four layers or strata, which, in sequence downward are the: 1. Upper cortex, 2.

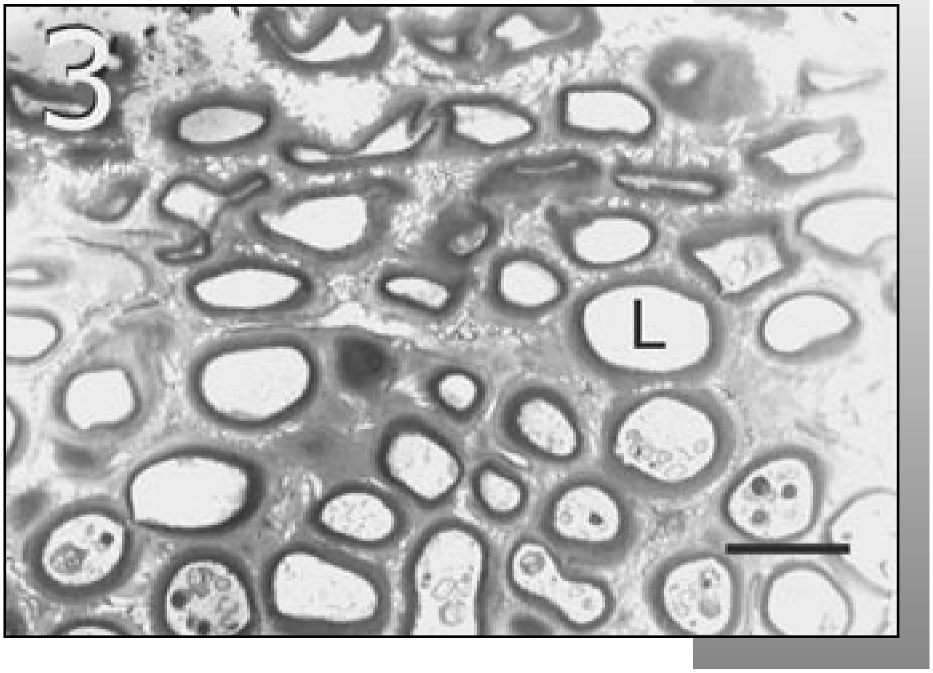


**Figure 3. A cross-section of cortex tissue in the lichen *Pleopsidium chlorophana*, 5000X TEM micrograph. Scale bar = 5 micrometers. This is a close up view of fungal hyphae within the lichen cortex. The cell walls have become quite thick. The cells merge with their neighbors, having become "conglutinated." The thick and hardy structure of the cortex provides strength for the lichen at its upper surface. Much of the cytoplasm in the cortex hyphae disintegrates when the cells are mature—see symbol L for lumen inside an empty fungal cell. This lichen fungus tissue, called prosoplectenchyma, is very similar to collenchyma tissues produced in higher plants. Since lichens are believed to be polyphyletic, this magnificent protective tissue would have needed to evolve many times independently in various lichen family trees, if evolution were true.**

Algal layer, 3. Medulla, and (in some lichens), 4. Lower cortex (see Figure 3; and Moore-Landecker, 1972, pp. 380–381; Fink, 1935, p. 4; Brodo et al., 2001, p. 4). A few lichens, especially those in which the phycobiont is a blue-green bacterium, have no specific "algal layer," and the phycobiont cells are distributed throughout the other layers. Such lichens are said to be "unstratified" or "homomerous" as opposed to the usual heteromerous or stratified condition in which a distinct algal layer occurs.

This stratification in lichens cannot be explained as having been caused by the lichen fungus living parasitically on algal cells, as Doyle (1965) realized: "…simple parasitism does not explain the extremely stable relationship and longevity of lichens under natural conditions, nor does it explain the resultant highly differentiated internal structure of most lichens" (p. 30). Stability, longevity, and differentiation do not arise as the result of parasitism. Brodo et al. (2001) described the stratified character of a lichen cross-section as follows: "Many lichens *are built* in layers and are said to be 'stratified" (p. 11, italics added). The phrase "are built" actually means constructed or assembled by the combining of parts. Stating that lichens "are built," tacitly affirms the action of a Builder, although Brodo and his coauthors probably did not intend to say that. "For every house is **built** by someone, but God is the **Builder** of all" (Hebrews 3:4).

## How Did the Fungi inside Lichens Originate?

Most of the material in a lichen is its fungus (Hale, 1961). The fungi found in most lichens belong to the ascomycete group, which includes fungi that synthesize ascospores in sacs called asci (ascus, singular). There are about 30,000 different species of ascomycete fungi, about half of which are involved as mycobionts in the approximately 5,000 species of lichens. The other ascomycetes are non-lichenized (Brodo et al., 2001).

According to evolutionary theory, it should be possible to find connecting links to show that individual, lichenized, ascomycetes descended from specific, non-lichenized fungus ancestors. But 70 years ago Fink (1935) admitted that the ascomycetes found in lichens are not similar to their non-lichenized counterparts. Fink rationalized and attempted to defend evolution by claiming that the lichenized ascomycetes "…must have become so modified, in many instances, since entering into relationship with the alga that there is little resemblance between them and the ancestral forms" (p. 1). Another way of viewing the lack of links between the lichenized and the non-lichenized fungi may simply be that they are not related—that the Designer created about half of the ascomycetes for bonding with algae and the others for a non-lichenized existence.

### Did Symbiosis and Evolution Produce the Vegetative Novelty Seen on Lichen Upper Surfaces?

Armitage and Howe (2004) noted that at least 20 different kinds of asexual or "vegetative" reproductive bodies are produced on the surface (dermis) of various lichens. This wide array found in lichen-associated, ascomycete fungi is not present in the "non-lichen" ascomycetes. To explain this difference, Budel and Scheidegger (1996) asserted that the symbiotic state of lichens must itself have triggered the proliferation of vegetative structures: "Symbiosis is now widely accepted as a source of evolutionary innovation…that has stimulated morphological radiation in ascomycetes" (p. 37).

It is gratuitous and unwarranted to assume that the reproductive novelties found in the lichen mycobionts arose by evolution and symbiosis. Scientific work simply shows that variety in fungi correlates with symbiosis; it does not prove that the variety was caused by symbiosis. To assume causality is invalid because correlation does not prove causality. For example, two phenomena may correlate not because either one caused the other but because a third factor controls them both. Changes in the price of eggs may correlate with changes in the price of beef, not because one causes the other but because of changes in the climate—a third factor controlling them both. Morphological variety and symbiosis might correlate in fungi because of design (a third factor) and not because the symbiosis somehow produced the morphological variety!

## Lichen Layers

### How Does the Top Layer, the Lichen Upper Cortex, Function?

The lichen upper cortex usually consists of "thick walled cells closely packed in a common, gelatinous, often tough matrix. The cortex serves the lichen as a protective skin" (Brodo et al., 2001, p. 13; see also Hale, 1976, p. 4). Although composed of elongated fungus filaments lying in various directions, the filaments "are so compressed as to appear cellular…" (Hale, 1961, p. 7). The cortex tissue is rigid because the fungus cells become conglutinated—heavily gelatinized, compressed, and stuck together (Figure 3) so that their walls actually unite (Hale, 1967). The cortex functions like epidermis tissue in other plants, conserving water, protecting the cells beneath, and ventilating the inner tissues. The gelatinous nature of cortex cells helps in water conservation.

Some lichen species have pores in the polysaccharide layer of the upper cortex "…exposing the underlying cortical hyphae and providing passageways to the algal layer for gas exchange" (Hale, 1973, p. 4). Fink (1935) noted that: "…these pores are to be looked for, in the most part, in the thinnest portions of the cortex, especially over areas where the algal cells are numerous" (p. 12). The functional value of such a relationship between pores, thin parts of the thallus, and algal cells beneath is obvious. The cortex and its pores allow the ready diffusion of carbon dioxide and oxygen gases involved in photosynthesis of the algal layer (Hale, 1976)

The multi-celled fungal cortex also serves as a light shield protecting the algae below from excessive solar radiation (Brodo et al., 2001). This protection results in part from the fact that certain "…orange and yellow pigments…are usually deposited only in the cortex" (Hale, 1967, p. 5).

Conserving water is achieved not only by the cortex, but sometimes also by asexual reproductive bodies known as isidia (Armitage and Howe, 2004). Jahns (1973) reported that isidia in the lichen *Parmelia saxatilis* "…grow into new thallus scales on the older part of the lichen" (p. 18). The isidia are effectively converted into thallus scales, which in turn become a stack of thalli, one on top of the other. The upper thallus in this stack remains alive, and the lower layers "…are used for water storage" (Jahns, 1973, p. 18). *P. saxatilis* does not exercise this water storage procedure when it grows where water is readily available. Where there is high relative humidity, "…no isidia and therefore no secondary thalli develop" (Jahns, 1973, p. 18). This self-regulated evaporation-control system is an amazing example of design.

Budel and Scheidegger (1996) also viewed the cortex as a line of defense against herbivores, blocking their immediate access to softer inner tissues. They maintained that the cortex modifies the energy budget of lichens. They found that in "sun-adapted" individuals of the lichen *Peltigra rufescens* there was a "decreased transmission of incident light" (p. 48) through the cortex, thus preventing overexposure of the algal layer to sunlight. Reduction of light penetration to the algae was not achieved by simply thickening the cortex, but by the synthesis of air spaces that reflect excess light, another novel feature.

Cortex structure in lichens "…makes possible an unlimited growth" (Bessey, 1971, p. 216). The manner in which the cortex and other tissues are arranged is ideal for expansion, allowing some lichen species to reach sizeable lateral dimensions. Lichens generally have a lobed shape because "initial cells" that cause lateral expansion are more active in some locations than others (Fink, 1935, p. 12).

### In What Ways Is the Lichen Cortex Like a Plant Epidermis?

On the outer cortex of various lichens there are diverse features such as tiny hairs composed of fungal hyphae, crystals of lichen acids, and even pores that expedite gas exchange (Moore-Landecker, 1972; Fink, 1935; Ahmadjian and Hale, 1973). Each of these surface phenomena has its own functional counterpart on the epidermal layer of higher plants (Armitage and Howe, 2004) These are obvious parallelisms found in very different living systems and they deserve an origins explanation. Evolutionary lichenologists assert that many different lichens and their pseudo-tissues evolved on numerous separate, independent occasions. They believe furthermore that the flowering plants independently produced tissues hundreds of millions of years later. Purvis (2000) believed that the lichen tissue structure "…evolved independently numerous times (polyphyletic)…" (p. 46) and he concluded that lichenization occurred independently in at least three different basidiomycete fungus lines as well as four times in various ascomycete groups.

To believe in the macroevolutionary origin of tissues, one must assume that lichen origins occurred repeatedly, requiring hundreds or even thousands of different events, yielding the many thousands of separate lichen species groups. In each of the parallel cases it would have been necessary for the two symbionts to have also yielded the same tissue structure. One must also assume that at a much later time, the flowering plants independently proceeded to evolve very similar tissues. Lichenologists usually do not mention the improbability of this scenario.

Lichens generally fall into one of three morphological categories, or somewhere between them: crustose, foliose, or fruitcose (Howe and Armitage, 2002). In addition to these, certain foliose lichens have only a single, stout, central peg of tissue (called a "holdfast") attaching the thallus to the substrate—resembling an umbilical cord, a mushroom, or an umbrella. These "umbilicate" lichens are connected to the substrate only at their center. Ordinary foliose lichens randomly bend upward from the substrate, connecting to it randomly at various points. Brodo et al. (2001) reported that: "…umbilicate growth form occurs in a number of quite unrelated lichens…" (p. 14). Hale (1976) wrote that the umbilicus "…developed independently in several totally unrelated parallel groups…" (p. 16). Again evolutionists rely on the unlikely prospect of polyphyletic parallelism.

## Would Lichens Have a Greater Chance of Survival if they Possessed a Cuticle on their Cortex Surface?

The lichen cortex resembles the epidermis tissue that covers the leaves and other organs of higher plants. But the plant epidermis usually has an outer cuticle layer composed of a waxy substance called cutin, which is effective in preventing excess evaporation. Hale (1976) made the following wistful claim about the absence of a cuticle on lichens that serves to illustrate the misleading comments made by some lichenologists: "Cutin is not produced by lichens and most species have not evolved any means of protection other than that provided by the outer layer of closely packed cortical cells…" (p. 8). Hale should have simply stated that cutin is the protective substance covering higher plant organs, while cortical cells protect lichens. By drawing evolution into the discussion, Hale committed the *petitio principi* logical fallacy of "begging" or bypassing the main question demanding proof—whether or not evolution had anything to do with producing the cortex covering lichens or the cuticle on higher plants. The global "success" enjoyed by lichens shows that no other feature except the cortex is either necessary or desirable for survival. Hale's remarks are irrelevant and misleading, as evolutionary comments can so often be in scientific discussions. Hale (1976) added that some lichens do possess "…a very thick polysaccharide layer…" (p.8) on their upper surface—a feature that provides additional protection against water loss.

## Cortex Photographs Explained

The cortex of three different lichens is visible in Figures 1, 2, and 3—*Xanthoparmelia sp.* (Figure 1), *Caloplaca sp.* (Figure 2), *and Pleopsidium chlorophana* (Figure 3). The empty lumens (cell cavities), where the protoplasm of fungal cells has disintegrated (Figure 3), are visible. The term prosoplectenchymatous (Greek *proso*=elongated, *plektos*=twisted, and *en chein*=poured into) is applied to cortex tissues like these, wherein the fungal cell walls are thickened, appearing to have been poured into place and glued together. These lichen tissues "…mimic higher plant tissues very closely" (Hale, 1976, p. 4; Hale, 1976; Hale, 1961, p. 4; Hale, 1967, p. 4). Fungus filaments in this prosoplectenchymatous tissue have a cellular appearance in cross-section.

The prosoplectenchyma of a lichen cortex is very similar in appearance and function to collenchyma (Greek *kollan*=to glue, and *en chein*=poured into), a support tissue commonly found in stems and other organs of higher plants. In it, cells likewise appear to have been glued together. The resemblance between the cortex of the lichen *Pleopsidium chlorophana* (Figure 3) and the collenchyma of a higher plant stem (Figure 4) is very close. Both supporting tissues look and function alike, although they arise in different taxonomic groups and by means of different developmental sequences, observations supporting creation, not neo-Darwinian evolution.

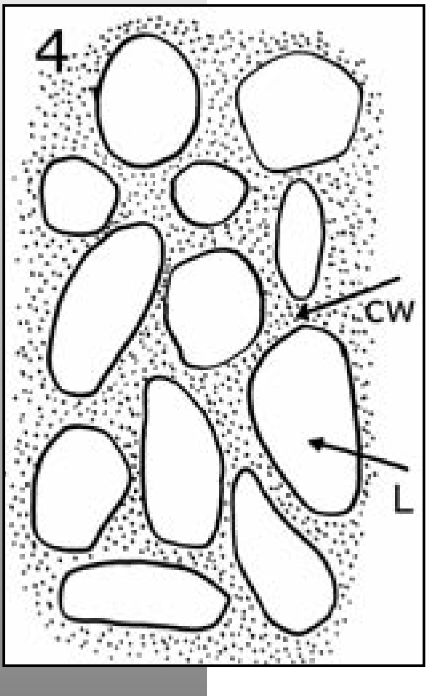


**Figure 4. A sketch of collenchyma tissue from a flowering plant stem. Compare this sketch of collenchyma from the stem of a flowering plant with the prosoplectenchyma of the lichen cortex, Figure 3. They have a structure that is almost identical. But since lichens are assumed to have evolved millions of years before higher plants, this type of protective tissue would have needed to have originated independently to give strength in flowering plant organs as well—an unlikely proposition. (Sketch by Patrick Armitage, after Figure 7.15 D, Robbins et al., 1964, p. 84.)**

## The Algal Layer: The Photosynthetic "Action" Occurs Here

The photobiont cells in many lichens are confined to a zone directly beneath the cortex (Figures 1, 2, and 5). This is the algal layer and numerous fungal hyphae are also present. In fact clumps of algal cells are loosely interwoven with the fungi surrounding the algal cell and often piercing them with haustoria. These are thin tubes through which photosynthetic products move from the alga to the fungus (Figure 7).

The positioning of photobiont cells below the cortex fungus layer is important to the success and survival of certain lichens. If the algae were located too close to the surface, they would be inadequately protected and would be in danger of drought, overheating, and overexposure to solar radiation. But if photobiont cells were buried too deeply in the thallus, they would receive insufficient light for optimum photosynthesis, thereby threatening the food supply of the lichen. This is true even though many lichens are "homoeomerous," with their algae distributed throughout the entire medulla layer and some in the cortex too.

The same lichen fungus that develops thick-walled, protective tissue in the cortex (Figure 3) has relatively thin cell walls in the algal layer (Figures 5 and 6 and Hale, 1961, pp. 7–8). Thinness of fungal cell walls in the algal layer fits their role of absorbing photosynthetic products from nearby photobiont cells. The fact that the fungus synthesizes thin walls in the algal layer facilitates the nourishment of the rest of the lichen. If it were to form walls as thick as in the cortex, movement of photosynthate from alga to fungus would be retarded. But if thin walls were made in both locations,

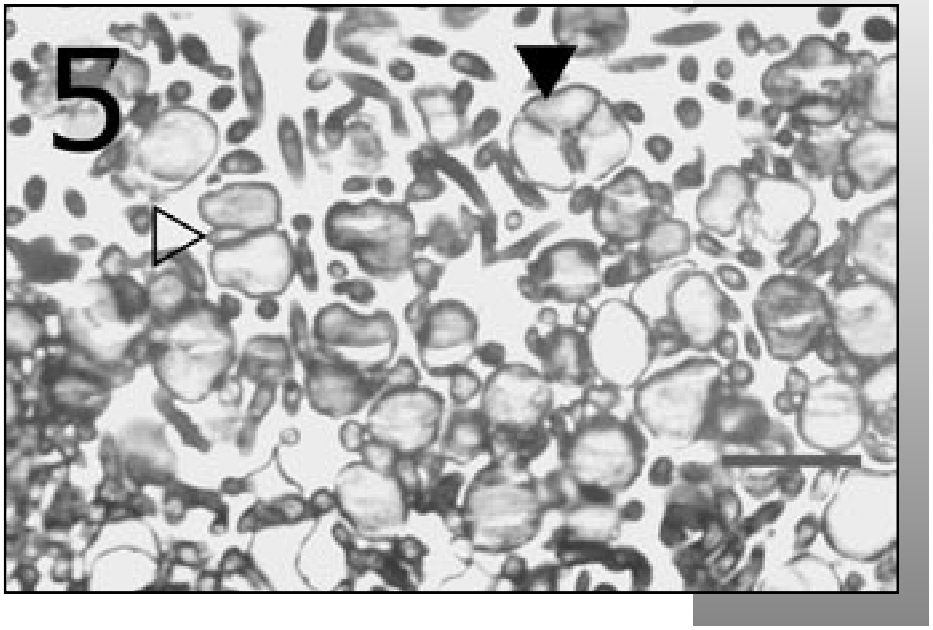


**Figure 5. A cross-section of the algal layer in the lichen *Xanthoparmelia*, 1000X brightfield micrograph. This is a close up view of the highly protected algal layer. The smaller, thin walled fungus cells can be seen in both cross and longitudinal-section surrounding and protecting the larger cells of an alga—presumably *Trebouxia*. The y-shaped algal cell (black arrowhead) has recently divided. Many fungus cells are closely appressed to algal cells (white arrow). Scale bar = 250 micrometers.**

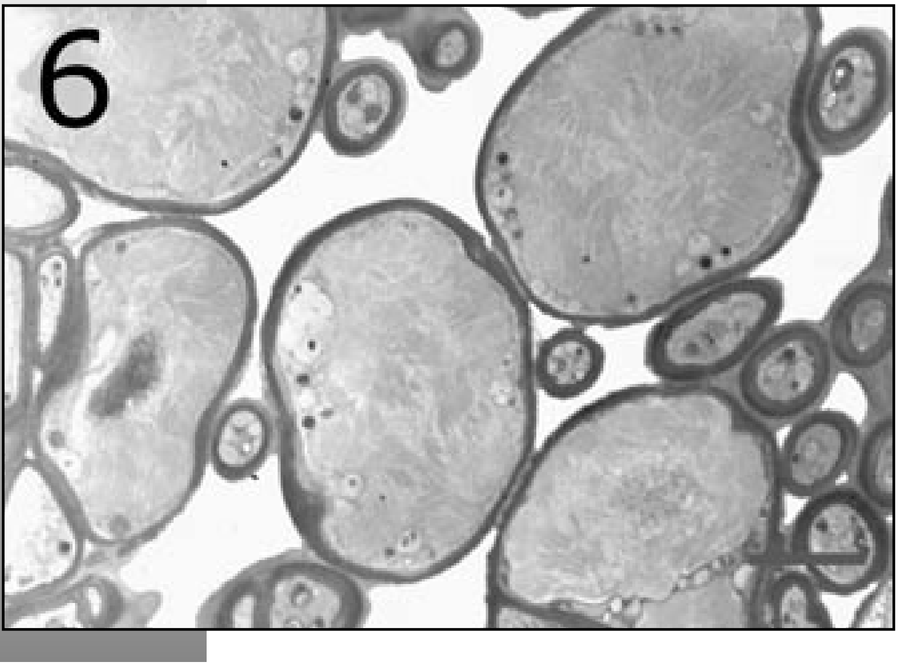


Figure 6. A cross-sectional close up view of algal and fungal cells in the algal layer of the lichen *Pleopsidium chlorophana*, 7000X TEM micrograph. The smaller cells (fungus filaments) are closely associated with the larger algal cells. Products of photosynthesis carried out in the algal cells can pass readily into the thin-walled fungus hyphae—an excellent design. The details of algal cell structure, such as pyrenoids, nuclei, and other features will be discussed in a future paper. Scale bar = 50 micrometers.

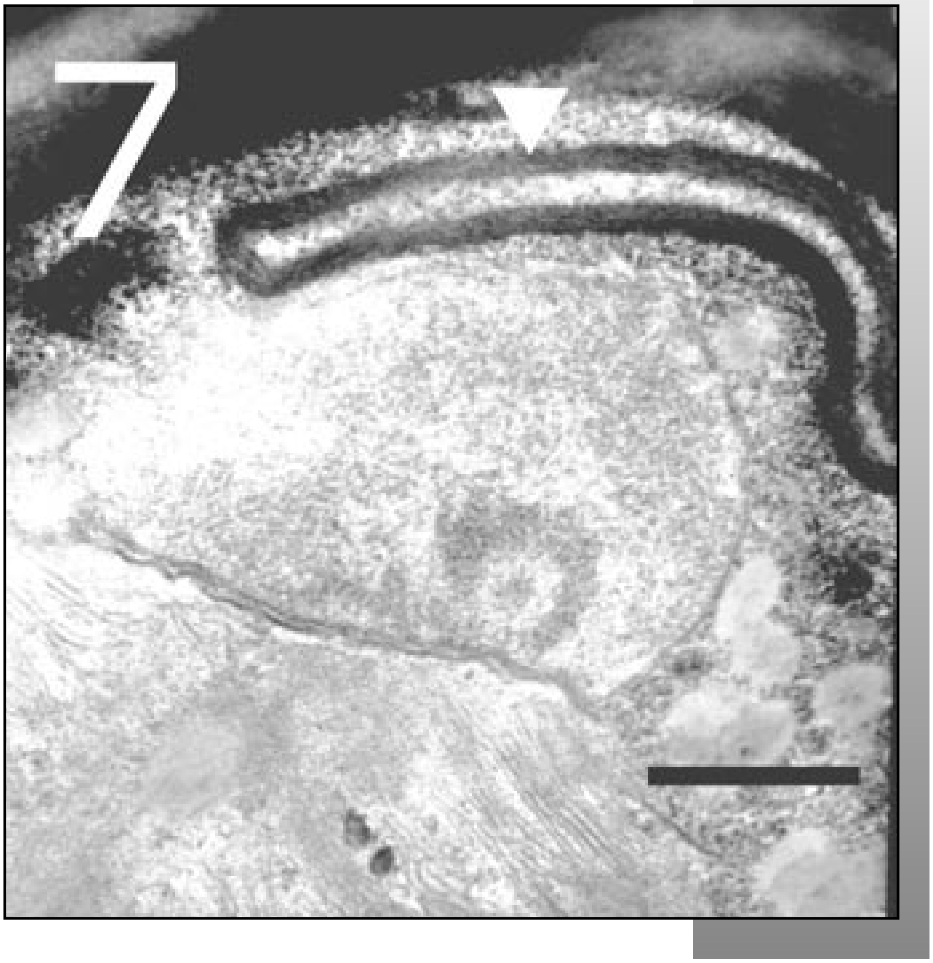


Figure 7. A fungal haustorium (haustoria, plural) located inside an algal cell, lichen *Candelilaria*, 8500X TEM micrograph. The nucleus, cell division, and the pyrenoid can each be seen in this algal cell—features to be discussed in a subsequent paper. Fungus hyphae are able to absorb photosynthetically produced foodstuffs not only by being closely appressed to the outside of algal cells but also by sending nutritive branches called haustoria inside the algal cells. A haustorium (white arrowhead) is visible here.

the cortex would be poorly equipped to protect the upper lichen surface. Fungus wall thickness in each layer fits its functions in that particular tissue. Attributing the origin of such detailed design features to the action of mutations and natural selection over long time periods, as evolutionists do, is tautological sophistry. Until the proper wall thickness had been developed, the lichen could not have lived and reproduced.

Hale (1976) indicated that some lichen tissues resemble the palisade layers of leaves in flowering plants (see also Hale, 1973). Photosynthesis of the lichen algae does occur in the algal layer, which is the counterpart of the palisade mesophyll leaf tissue. The algal layer in lichens is similar to the palisade photosynthetic tissue in another way—both are surrounded by non-photosynthetic layers, above and below.

As far as we can determine, the photobiont found in each of the lichens studied in the VACRC collection is a species of *Trebouxia*, a green algal genus. There is no handbook telling which alga is present in each species of lichen. Brodo et al. (2001) noted that "The photobiont of only 2 to 3 percent of all lichens have been identified to the species level" (p. 4). Perhaps this paucity of information occurs "…because the algal colonies have been modified by the fungus to the point of being unrecognizable" (Hale, 1967, p. 8). By "modified" he was not referring to a genetic modification by evolution but to a phenotypic algal modification caused by the adjacent symbiotic fungus.

Hale (1961) reported that 30 different algae have been identified from lichens, but that the "…majority of lichens contain the green alga *Trebouxia* (phylum Chlorophyta)" (p. 3). In a subsequent paper, we intend to illustrate and discuss some of the amazing features visible in *Trebouxia* cells and in the lichen fungi at high magnifications.

The presence of *Trebouxia* in so many lichens is evidence favoring creation. *Trebouxia* is "…rarely found in the free-living state in nature" (Moore-Landecker, 1972, p. 30). There are three characteristics of *Trebouxia*, which are disadvantageous for life in the free state and yet actually equip it for growing inside lichens: 1. *Trebouxia* requires very low light intensities for optimum photosynthesis, 2. *Trebouxia* has a relatively slow growth rate, and 3. *Trebouxia* cells have an unusual "preference" for organic nitrogen sources [carbon-containing molecules that have nitrogen as part of the molecule] instead of the prevailing inorganic ones. These peculiarities favor it for growth in association with a lichen fungus (Moore-Landecker, 1972).

First, concerning the requirement for low light intensities, *Trebouxia* cells grow beneath the lichen cortex where light intensities are relatively low. Second, the slow growth rate of *Trebouxia* cells correlates well with the slow overall growth rate of most lichens. And third, nitrogen supplies inside the lichen are normally in the form of organic nitrogen, which *Trebouxia* cells favor—another trait helping *Trebouxia* to live inside lichens. Likewise, the production of asexual reproductive bodies called aplanospores is suppressed in the *Trebouxia* cells growing in lichens (Moore-Landecker, 1972; Bessey, 1971). This ensures that the algal aplanospores will not routinely unite with fungus filaments to form lichens *de novo*. This maintains a stability of each lichen species and also conserves cellular energy that would otherwise be spent forming useless algal reproductive bodies. The very "deficiencies" of the alga *Trebouxia* pre-"design" it for symbiosis.

## The Lichen Medulla Layer and the Roles It Plays

The medulla is a large, loosely woven, center region of lichens where food, water, and acids are stored—see Figure 8 and consult Hale, 1967. Fungal cell walls in the medulla (Figure 9) are thick, which affords a firm but relatively open framework below the algal zone. In their loose arrangement, thick walled medullary hyphae provide a strong center support while simultaneously supplying space for air and water. Wall thickening in the medulla results from the secretion of microfibrillar polysaccharide layers.

In many of these medulla cells, the cell cavity inside the cell wall, known as the lumen, has been all but obliterated by the deposition of secondary cell wall layers (Figure 9). Cells with greatly thickened cell walls are known in higher plants as "sclerenchyma" (*sclera*=hard and *enchein*=poured into, Greek). The walls cells in medulla cells closely resemble sclerenchyma cells of the taxonomically distant flowering plants—another puzzling, "long distance" parallelism that suggests design.

The lichen medulla is up two-thirds or more of the lichen thallus thickness and most of its bulk (see Figures 1 and 8) (Hale, 1961). Loosely packed filaments in the medulla are metabolically active, making it the ideal area for food storage. Some of its filaments are so closely involved in storage that they are called "fat cells." Crystals of lichen substances may also be conspicuous in the medulla (Hale, 1973).

In contrast, the mesophyll cells of higher plants contain chloroplasts; medulla filaments do not. Nonetheless, the medulla organization resembles the spongy mesophyll tissues located below the palisade tissues in leaves of higher plants. It strains scientific credibility to continually suggest that these

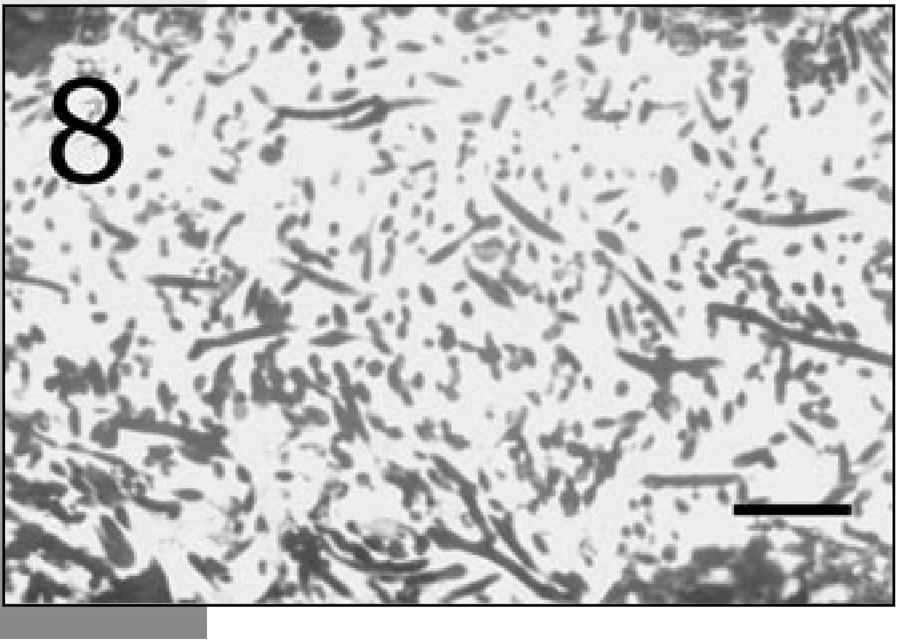


**Figure 8. A cross sectional view of the medulla in the lichen *Xanthoparmelia*, 500X brightfield micrograph. The medulla is a massive center tissue in the lichen, a tissue which provides support and structure while allowing much space for water, air, and storage. Scale bar = 400 micrometers.**

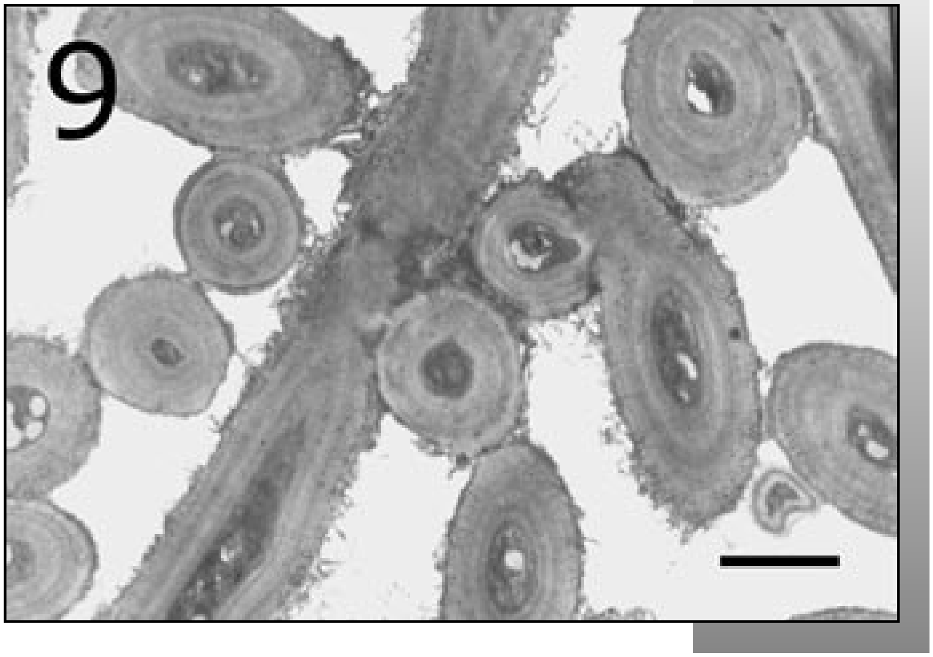


**Figure 9. A close up view of cross and longitudinal-sections of fungal hyphae within the cortex of the lichen *Xanthoparmelia sp.*, 5000X TEM micrograph. Although there is much space between fungus hyphae in the medulla, the very thick walls provide a strong, central structure for the lichen. The secondary cell walls are quite thick so that very little space remains in the cell lumen for the cytoplasm or the nucleus. Such ultra-differentiation turns these inner fungal filaments into firm rods that closely resemble sclerenchyma fibers produced independently in the vastly distant flowering plants. Striking resemblances between tissues of widely different organisms support creative design rather than evolutionary common ancestry. The same fungus produces thick cell walls, as needed in the upper cortex and in the medulla but it produces thin cell walls for absorption of food in the algal layer. Cell wall design matches function in each lichen layer. Scale bar = 5 micrometers.**

tissue similarities have evolved many times independently in the origin of many different lichens and that they arose once again in flowering plants!

The medulla also transports minerals from beneath to the algal and cortex tissues above. Foods move downwards from the algal layer, through the medulla, and into the lower cortex (Fink, 1935).

## The Lower Cortex Layer—Is It Present or Absent?

The presence or absence of a lower cortex usually correlates with the type of the lichen: foliose versus crustose (Fink, 1935). The only lichens needing a lower cortex (the foliose ones) have one. Foliose lichens are somewhat wrinkled and unattached to the substrate over much of their lower surface. Were it not for a lower cortex, much of that lower surface would be exposed to the atmosphere and subject to desiccation (Figure 10).

While the lower cortex plays a role in foliose lichens, its absence from most crustose lichens is likewise evidence of design. Crustose individuals are attached at all points to the substrate, obviating the need for a protective lower layer (Hale, 1967).

The lower cortex resembles the upper cortex except that it is thinner (Fink, 1935) and frequently has hair-like rhizines (Hale, 1961). Rhizines are compacted strands of hyphae that foster absorption and attachment (Hale, 1967). They are not to be confused with "rhizomes," which are horizontal stems found in certain flowering plants.

In addition to rhizines, some lichens possess other hair-like structures known as cilia—appendages that originate from the thallus margins. Hale (1967) wrote that the cilia "appear to be related to rhizines although in view of their diversity they may well have originated in several ways" (p. 23). This is another example of the independent, polyphyletic origin of a parallel feature (cilia) in different lichens. The presence of cilia in otherwise unrelated lichens supports creation, not macroevolution.

The thinness of the lower cortex is likewise a profitable design. If it were thick, like the upper cortex, the lower one would hinder absorption from beneath. Its thinness is a good design for both the roles it plays—absorption and attachment.

The lower cortex has no gas exchange pores (Hale, 1973), similar to those found on the lichen upper cortex. They would be of no value and might even cause harm. Each tissue is fitted for its functional requirements.

Genetic controls are required to govern these various differences between the lower and the upper cortex. The same genes that cause the upper cortex to be a thick, conglutinated mass of cells (Figure 3) with gas exchange pores present, must direct the lower cortex to be thinner, to produce rhizines, to not make pores, and to facilitate the absorption of minerals and water (Figure 10). The ability of the same genome to produce tissues with such distinct variations requires design engineering, which has not been shown to originate by natural selection working on gene mutations.

## What Is the Ball Seen in Lichen Sections?

We think the large, circular object visible in our photograph of *Xanthoparmelia* (Figure 1) is an ascocarp reproductive structure of the ascomycete fungus. Lichen ascocarps originate in the medulla (Fink, 1935), where fungus hyphae grow together to form a spherical structure. Gradually a developing ascocarp moves upward from the medulla, through the algal layer, and into the upper cortex. The one in Figure 1 is partly in the medulla and partly in the algal layer where it is displacing some of the algae and fungus filaments. Fink (1935) noted that young ascocarps going through development "may scarcely be discernible in any way except in sections of the thallus" (p. 4). Fink (1935)

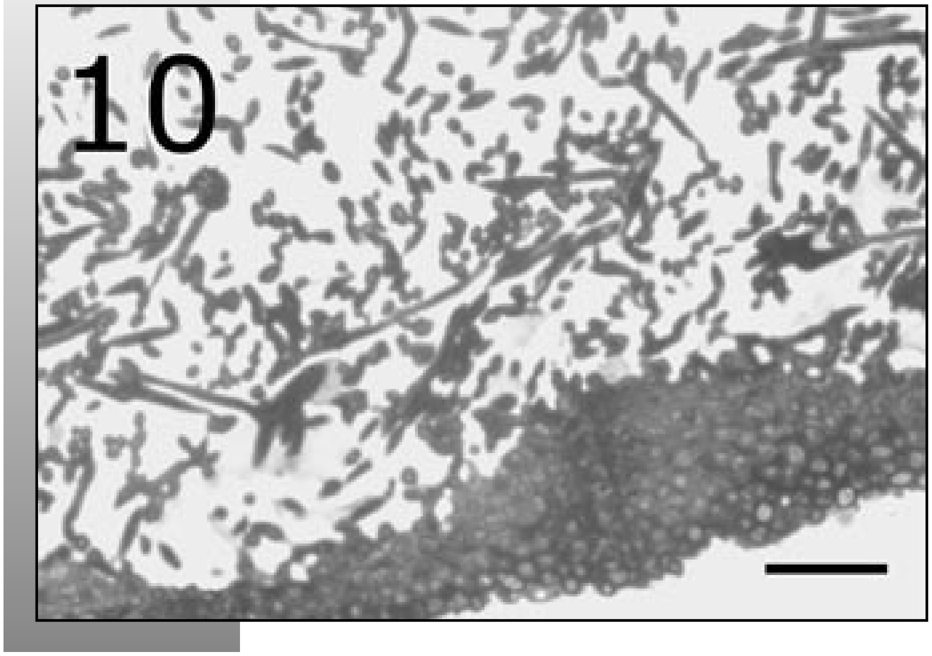


**Figure 10. A cross-section of the lower thallus of the lichen *Xanthoparmelia*, 500X brightfield micrograph. It is profitable that the lower cortex (LC) be present on the bottom of a foliose lichen like this species, to prevent desiccation from beneath. But it is also advantageous that crustose lichens have little or no lower cortex because they make total contact with the substrate beneath. Fortunate design features like this one favor the creation origins scenario rather than a chance-based evolution theory. Scale bar = 400 micrometers.**

also described the appearance of one type of ascocarp, an apothecium, in a section of a thallus: "…the outline of transverse section of the apothecium, when young, would usually be very nearly a perfect circle; but the form may become very irregular as growth proceeds, so that at maturity this outline is quite irregular" (p. 4).

Most ascocarps ultimately open to the exterior at the upper surface, forming a small pore or a broad cup (Howe and Armitage, 2003, Figure 6). When it is mature, an ascocarp produces sacs called asci (ascus, singular). Inside each ascus, meiosis cell division occurs in the production of four or eight ascospores, depending on the species of ascomycete involved (Hale 1961). Why the lichen fungi produce these ascocarps, asci, and ascospores when they appear to be of no value either to the lichen itself or in the synthesis of new lichens, is a puzzle to both creationists and macroevolutionists (Howe and Armitage, 2003; Ahmadjian, 2002).

## Does the Medulla Send Dead Cells Upward?

Only one of the dozens of lichenologists whose writings we have studied discussed cell movement upward. It has a possible bearing on functions of lichen tissues, however, and it should either be substantiated or clearly refuted in the literature. There is an upward movement of fungal cells and dead algal cells into the dermis above. Fink (1935) noted that by this gradual upward passage of tissues, dead, "...entangled algal cells are at length carried off by the abrasion of the upper surface" (p. 8). This upward movement converts the cortex cells into filaments of the dermis tissue, ultimately ridding the lichen of dead algal cells at the top. Hale (1973 and 1976, p. 10) made only a brief mention of atranorin as being a substance that is apparently synthesized near the algal layer, and "…seems to migrate into and through the cortex and eventually becomes deposited on the surface of the epicortex" (1976, p. 10). This comment also suggests a general upward movement.

If a sloughing of old cells does occur in lichens, it would be the counterpart of a cork cambium found in the taxonomically distant flowering plants, a tissue divides to form new cells under the bark, thereby replacing outer ones that die and fall off. The ability of a lichen to repair itself from inside out by continually removing dead cells, would be yet another evidence of intelligent creation. This needs further study.

## Conclusion

Some of the tissue systems in lichens have a close functional and structural similarity to tissues of flowering plants, which are so distant in plant classification that they are in different kingdoms. Haunting resemblances between plants in widely separated corners of the botanical world support creation by a common Designer, not macroevolution from a common ancestry.

Lichenologists periodically refer to neo-Darwinian evolution in their analyses of lichen anatomy, but in so doing, they often demonstrate how useless and meaningless evolutionism is in these scientific discussions. Many aspects of lichen tissue structure and physiology require further research; ideally, creation scientists will carry many of those future studies out.

Lichen tissues display a great complexity of structure and function. Such design strongly supports the existence of an extremely intelligent Designer who played a very active role in the origin of lichens. The study of lichens themselves gives us a view of the capabilities of the Creator.

## Acknowledgments

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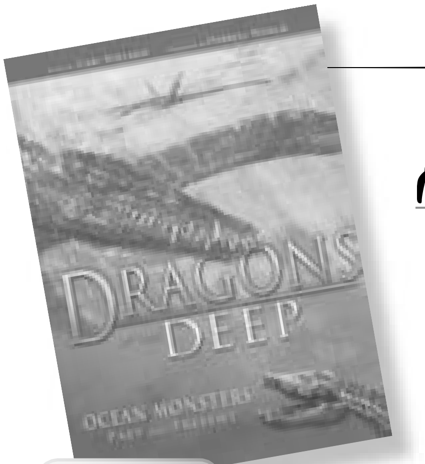
# Book Review

## *Dragons of the Deep* by Carl Wieland

**Master Books, Green Forest, AR, 2005, 80 pages, $16.00.**



AVAILABLE THROUGH CRS BOOKS!

This fully-illustrated book is written for children. It is filled with pictures of marine reptile monsters from the past so kids will love it. The words used will add to the vocabulary of all readers from age 5–95, including behemoth, coelacanth, ichthyosaur, kronosaurus, mesonychoteuthis, ophtalmosaurus, turbidity currents, and xiphoctinus. Author Wieland concentrates on the large creatures of the sea, both past and present. A *sarcosuchus* fossil was found in the deserts of North Africa in 2001. It was a 40 foot long "super croc" twice as big as living saltwater crocodiles (pp. 44-47). This fearsone beast may be the leviathan described in Job 41. *Archelon* was a sea turtle weighing five tons and 16 feet long, larger than a car (pp. 60-63). Its fossils are found in the mid-northern U.S. *Mesonychoteuthis* is thought to still live in deep Antarctic waters, a colossal squid twice the size of the better known giant squid (pp. 30-32). Body parts of the impressive squid have been found inside whales. With the tentacles, its length exceeds two school buses.

The list goes on with creatures that were armor-plated, some with eyes as large as dinner plates, others carrying over 100 pounds of gizzard stones, and a tarpon-like fish weighing 800 pounds. Some of these creatures, thought to be extinct, may still be with us. The case is made that all sea creatures were at on time vegetarian in agreement with Genesis 1:30. The book is in full color and includes a helpful index. Thanks to author Wieland for reminding us of the dramatic living treasures of the sea.

Don B. DeYoung

# Notes from the Panorama of Science

## Uniformity and Uniformitarian Concepts in Sedimentology

In discussions with some contemporary geologists, it has become apparent that Lyellian Uniformitarianism is regarded as a relic of the past. "Modern-day geologists have moved on," they say. "We are now as open to catastrophism as anyone, but we need to be persuaded by the evidence." However, despite these affirmations, it is also apparent to me that many of these geologists continue to think in uniformitarian ways. It appears to be very difficult for them to get out of the deep conceptual ruts created by Lyellian geology!

One of the ways the uniformitarian mindset is perpetuated involves an appeal to the laws of physics. "You cannot escape the fact that this is how nature behaves!" A popular specific example involves Stokes' Law, which describes the way a particle in suspension moves through a fluid under the influence of gravity. By putting appropriate figures into the equation, it is a simple matter to show that some fine-grained sediments must have taken a long time to settle out of suspension. "For these sediments, catastrophism has to be ruled out of consideration—QED!" To the unwary, this argument sounds compelling, for who dares to challenge tried-and-tested laws of physics?

The root problem to address here is reductionism. The argument is made by people who think they understand the building blocks of our world and the way they interact. This allows them to build up a picture of the whole that they consider to be complete (this thinking, for example, lies behind the elusive "Theory of Everything"). There are at least two fallacies: first that we understand all the building blocks and second, that we understand the way they interact! In what follows, we shall consider three types of sediment that have all been claimed to accumulate slowly and elaborate on the two fallacies. The sediments are volcanic ash deposits, diatomite and chalk.

### Volcanic ash from a recent eruption from Mount Pinatubo

In 1991, Mount Pinatubo in the Philippines erupted and large quantities of volcanic ash fell into the sea. Application of Stokes' Law suggested a timescale for settling of three months, but an ash layer formed on the seabed within three days (Wiesner et al., 1995). Clearly, something was missing from the analysis. It is not that Stokes' Law is wrong: no one thinks that the laws of physics changed in any way. The problem was in the model of deposition. It was deficient because the ash particles did not behave as independent particles in suspension (as they would have to do if they were to be described by Stokes' Law). Alternative theories to explain the data were considered by Manville and Wilson (2004). Their work was supported by laboratory experimental simulations and the conclusion they reached was that the ash fall on the ocean surface produced density currents that flowed vertically to the sea floor. In other words, the ash fall created a fluid of higher density than seawater and that fluid descended coherently through the water column. (These authors also found evidence for rapid diagenetic processes, but that does not concern us here because our focus is on deposition.)

This is an example that concerns the *interactions* of particles in suspension. Instead of behaving independently, a density current formed that moved "two to three orders of magnitude greater than expected" (Wiesner et al., 1995, p. 887).

### Diatoms from the Eocene of Chile

Diatoms are the siliceous bodies of unicellular algae living in oceanic surface waters. When they die, the frustules (the siliceous skeletons) descend to the ocean floor and become part of the accumulating sediment. Diatom sizes are commonly in the range of 10–200 μm. According to Stokes' Law, individual cells with these sizes require 1 week to 2 years to be deposited. In modern ocean basins, diatom frustule and mud accumulation rates are low (one study off the coast of California reported a rate of 40–73 cm of sediment in a thousand years). Geologists refer to "diatomaceous ooze" when the proportion of diatoms becomes significant. Diatomaceous deposits are of commercial interest because they are made up of relatively pure silica in a hydrated form that favours chemical processing. Mineable deposits are typically inferred to have formed over thousands of years.

By analogy with the volcanic ash example, is it possible for diatoms to form quickly and to be deposited quickly? Are there modes of deposition other than the "independent particles in suspension" that is described by Stokes' Law? The answer to this is undoubtedly "yes." For example, it is known that many planktonic diatoms should not be regarded as individual cells because they form multicellular chains. These can be several mm in length.

However, the major evidence for more rapid modes of deposition comes from the presence of fossil vertebrates in some diatomite beds. The most striking case concerns fossilised baleen whales in diatomaceous rocks in the Cerro Bianco region of Peru. The lower part of the Pisco Formation is mostly sandstone with some diatomaceous units. The upper part, about 80 m thick, has diatomaceous units plus mudstones with volcanic ash. Within this unit are fossil baleen whales, 5 to 13 m long, many of which are extremely well preserved. In recently reported research (Brand et al., 2004), 346 whales were studied in a 1.5 km$^2$ area of exposed ground. These fossils occasionally preserved soft tissues, including baleen. The only other common fossils are sharks' teeth, but the formation has also yielded fish, turtles, seals, porpoises, penguins and even ground sloths.

Brand et al. considered three mechanisms of deposition: (1) anoxia in stagnant water, preserving the whales while sediment accumulated slowly, (2) diatom mats were rafted in to cover the bodies and inhibit scavengers, and (3) rapid burial by diatomaceous sediment. Their paper discusses relevant observations, rejects options 1 and 2, and concludes that option 3 is supported by the evidence.

"This necessity of rapid burial indicates that, at times in the past, diatom accumulation rates were much higher than those typical in modern oceans" (Brand et al., 2004, p.168). The mechanisms suggested are abundant diatom blooms offshore (i.e. an "explosion" of the diatom population as a result of abundant food supply and favorable conditions for reproduction) combined with currents bringing frustules to a region of accumulation. This research, therefore, documents a convincing case of these sediments accumulating over much shorter timescales and it succeeds in injecting a catastrophist alternative to what has hitherto been a uniformitarian stronghold. The "Stokes' Law sedimentation" of particles has to be perceived as one extreme of a spectrum of depositional modes.

This case concerns the *building blocks* of diatomite formation. Although diatom blooms are known today, we have no records of events that match up to the Cerro Bianco deposits. Processes in the past have gone well beyond present-day experience. The presence of volcanic ash in these deposits may be significant—as is discussed below.

## Chalk from the Cretaceous Period

The most challenging case involving the deposition of small particles concerns chalk. This sediment is made up of the calcareous residues of certain algae known as Coccolithophores. The hard parts are called coccoliths, and their effective settling diameter is in the range 2 to 12 µm. These structures disaggregate to produce fragments in the range 1 to 4 µm. Since the wavelength of red light is about 0.7 µm, it was not possible to resolve the structure of the chalk until the advent of scanning electron microscopes. The larger particles require at least a year to descend to the sea floor, but disaggregated particles might take over 100 years! According to some estimates, 1 m of chalk represents about 100,000 years of time. In the modern oceans, coccolithophores are found in nutrient-poor waters and the coccoliths are always mixed with other materials in the sea-floor sediments. Deep sea chalk oozes from the Atlantic have a coccolith content (by weight) of 5–33%, and from the Indian Ocean 4–71% (Jeans and Rawson, 1980).

All the more surprising, then, to find chalk in abundance during the Upper Cretaceous and also represented in some Tertiary strata. This means that in the past, there were large areas of sea-covered continent, dominated by chalk-producing algae with relatively minor inputs of other sedimentary material. At best, with such slow rates of dropping out of suspension, we should expect to find only chalk oozes. Nevertheless, many of the chalk deposits are extraordinarily pure and very thick (about 350 m in southern England, and in the US the Niobrara Formation has a chalk member that averages about 180 m). Many have concluded that these chalk deposits must have been formed in ways that are unrepresented by modern-day processes: "no exact analogue of Cretaceous chalk can yet be quoted" (Jeans and Rawson, 1980, p. 92). Further information on the unusual characteristics of chalk strata are found in Tyler (1996).

Even conventional geology needs to find ways of depositing chalk faster than that allowed by Stokes' Law. One mechanism favoured by some is that coccoliths have typically been ingested by other organisms and excreted as coarser particles. These coarser aggregations fall out of suspension relatively quickly. This explanation has the merit of explaining significant differences in the textures of certain chalk sediments.

Other avenues of thought can be explored, of course. There is the possibility of forming algal blooms, with greatly increased rates of coccolith formation. The conditions for sustained explosive growth have yet to be identified in detail, but the basic idea has been discussed by Roth (1985) and developed by others.

It has been known for some time that iron can seed algal blooms, but experiments in the oceans have not been easy to interpret. Recent work with iron seeding has indicated that the mere presence of iron is not enough—it must be in a form that organisms can actually use. Two storms carrying iron-rich dust from the Gobi Desert into the Pacific Ocean have provided important insights into some relevant processes. Meskhidze et al (2005) provide the documentation.

As the storms passed over China, they picked up sulphur dioxide pollutants. It appears that a relatively high level of sulphur dioxide is able to convert the iron to a more soluble form that phytoplankton can use. The first storm resulted in an increase in phytoplankton but the second did not. The latter had a significant amount of carbonate dust to neutralize the $SO_2$.

One of the benefits of abandoning uniformitarian thinking is that previously unconnected data can be integrated in remarkable ways. This relates to the "interaction" weakness of uniformitarianism. It is well known that volcanic activity emits iron-rich dust together with large quantities of carbon dioxide and sulphur dioxide. Indeed, this phenomenon has led to people challenging Diluvialists about the extremely toxic environments that must have occurred during the catastrophism of the Flood and its after-effects. However, it now emerges that there are feedback mechanisms. Volcanism can boost phytoplankton growth (algal blooms) by introducing iron-rich dust and sulphur dioxide to ocean waters, increase the uptake of $CO_2$ (during photosynthesis) and generate lots of oxygen. Here is a feedback mechanism to help keep our planet in a fit state for life during any time of global instability involving volcanism.

The above scenario involves algal blooms in abundance. What is the situation with coccolith-producing algae? Coccolithophores have been described as among the fastest growing planktonic algae, yet unlike other most other photosynthetic plankton they do not appear to respond to fertilization by nitrate, phosphate, or iron. How then can these organisms be stimulated to bloom?

A significant breakthrough in understanding the environmental factors promoting chalk production has come from Stanley et al. (2005). These authors noted that low Mg/Ca ratios and high Ca concentrations characterized Cretaceous seawater. Also, that Paleocene seawater had Mg and Ca concentrations close to Cretaceous levels. Modern seawater has a high Mg/Ca ratio and about half the Cretaceous Ca concentration. The authors' hypothesis was that seawater concentrations were significant and they devised a set of experiments to test this out.

The authors were aware of nearly 300 coccolithophore species, mostly living in low abundance in nutrient-deficient subtropical/tropical gyres of the ocean. Three species were chosen for experimentation, and all responded strongly to Cretaceous seawater. One doubled its population growth, and the others had "exponential growth rates three to four times as high in Cretaceous seawater as in modern seawater" (Stanley et al., 2005, p. 595). One species changed the character of its coccolith generation: it "secreted larger and more heavily constructed coccoliths in Cretaceous seawater."

Stanley et al. (2005) suggest that modern-day coccolithophores are living in what amounts to a refugium. They do not thrive in high-Mg water. The factors affecting blooming still need attention, but this paper takes us a great deal further in explaining why Chalk is primarily a Late Cretaceous phenomenon, why modern-day coccolithophores do not show any signs of generating significant thicknesses of chalk, and in showing that, when conditions are right, these little organisms can multiply fast.

As far as chalk is concerned, would blooms have resulted in density currents? Would they lead to the aggregation of coccoliths? How would coccolith falls from blooms have affected the unique ecosystems that appear to have lived on the chalk sea floor? Although the answers to these questions are not yet clear, there must be mechanisms, because there is enough evidence for suspension settling by Stokes' Law to be ruled out as an option.

## Conclusion

These issues help to illuminate the problems of uniformitarianism. It is not that uniformitarians are not prepared to accept evidences of catastrophism in the geological past. Rather, it is that uniformitarians have a very narrow perspective on geological phenomenon. They prefer to work with modern analogues and physical laws without testing "goodness of fit" and without exploring alternative hypotheses that allow equally good or improved correspondence between observation and theory. In the above three cases of sedimentation of fine particles, uniformitarianism has failed because of an inadequate understanding of the "building blocks" and their interactions. As far as I can see from research being published, significant advances are only coming when researchers are prepared to step outside the mould and question received wisdom.

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David J. Tyler
c/o P.O. Box 22
Rugby, Warwickshire, CV22 7SY, UK

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# Spur and Groove Coral Reef Morphology

## Introduction

Numerous patch reefs occur along the Florida Keys Coral Reef Tract. They are composed of a variety of soft and hard coral-producing organisms, with many exhibiting a similar geomorphic structure identified as spur and groove morphology. This hard coral framework has also been reported at reefs around the world. Even some "prehistoric" reefs appear to exhibit this morphology. Spur and groove morphology at the Florida Keys Coral Reef Tract demonstrates intelligence in its design and a preferred end state for the growth and development of a healthy Elkhorn coral-dominated (i.e., *Acropora palmata*) patch reef.

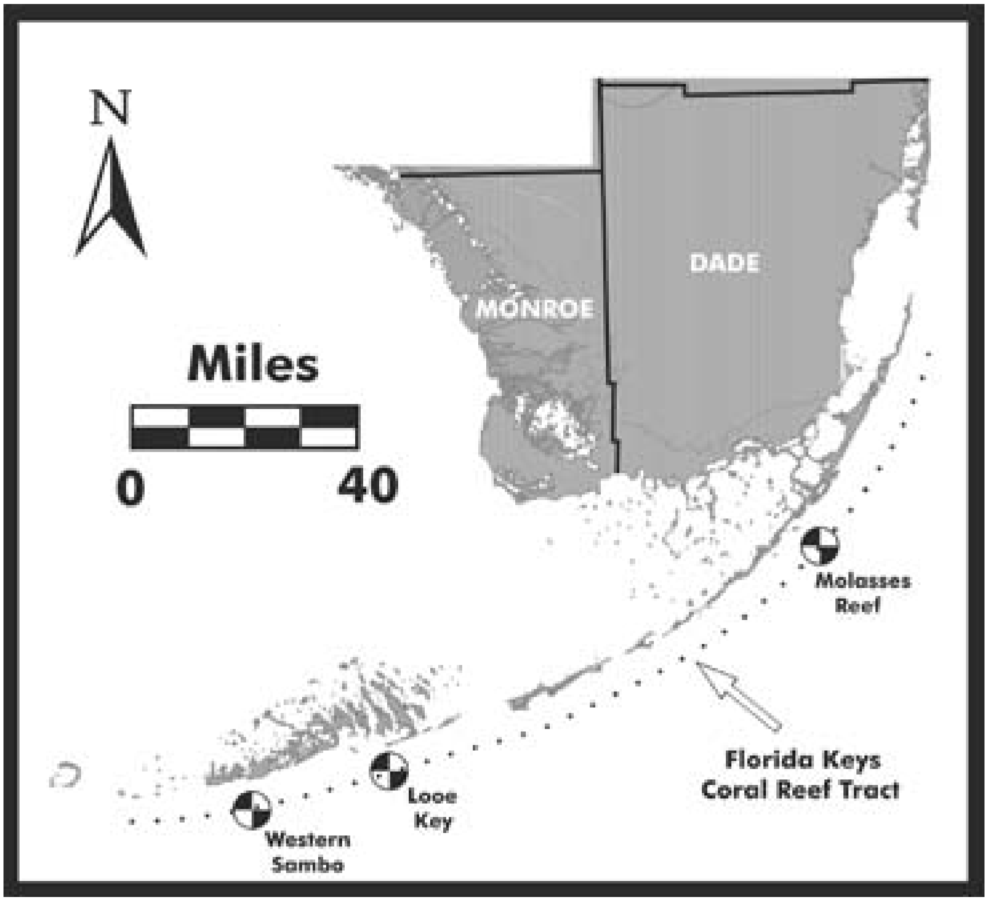


**Figure 1. Base map showing location of Western Sambo Reef, Looe Key Reef, and Molasses Reef. The modern coral reef tract (represented by the dotted line) is located several miles offshore and is composed of numerous patch reefs, many of which exhibit spur and groove morphology.**

## Spur and Groove Morphology

The term "spur and groove" was first used by Shinn (1963) in reference to coral reef morphology identified at various patch reefs along the Florida Keys Coral Reef Tract (Figure 1). Previously, this reefal structure was referred to as the buttress zone at a reef in the Pacific Ocean (Odum and Odum, 1955). In describing spur and groove morphology, Shinn (1963) stated:

> The "spur and groove" system is a geomorphic feature that is present on the seaward side of most reefs ... Externally, spurs are coralline fingers as high as 30 feet that are separated by grooves ... On Florida reefs, the spurs vary in width from

> 25 to 200 feet and extend into the prevailing seas and swells several hundred feet and down to depths of 100 feet (p. 291).

It should be noted that while spurs and grooves were found at some depth, there are actually two terraces of coral reef exhibiting spur and groove morphology in places along the Florida Keys reef tract; only the shallow portion of the reef (water depths less than 25 ft) demonstrates active Elkhorn coral (i.e., *Acropora palmata*) growth (Figures 2 and 3). The lower terrace is covered with bladed growths of *Milleopora complanata* that have overgrown dead spurs of *Acropora* (Shinn, 1963).

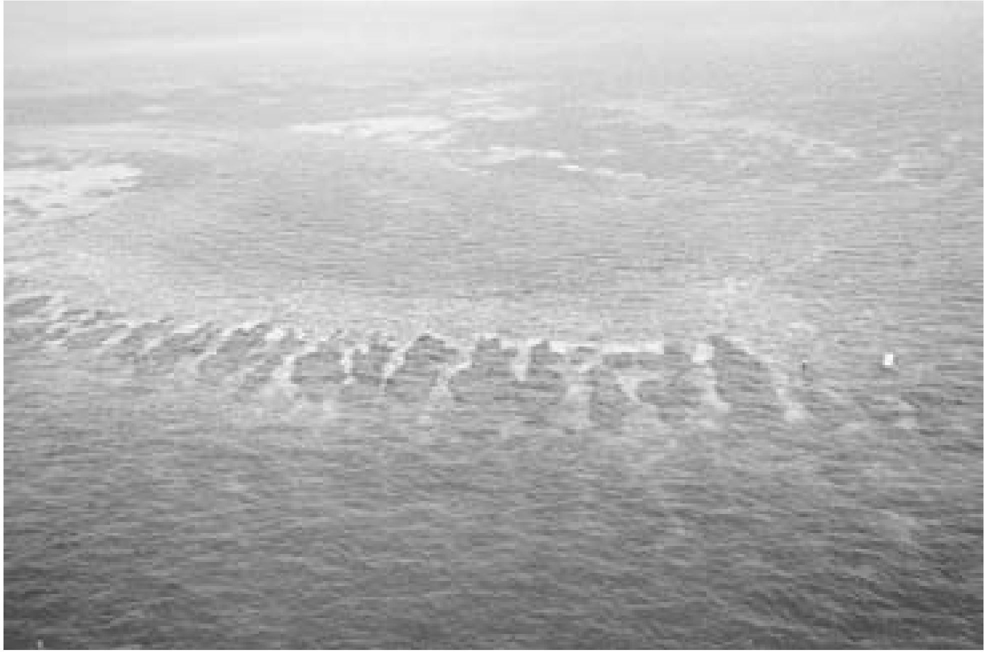
According to Enos and Perkins (1977), scleractinian corals:

> ...are the most spectacular organisms of the south Florida shelf. Their distribution is among the most clearly zoned ... *Acropora palmata* ... is the chief framework-former of the outer reefs. It is the prime indicator of maximum wave action and open circulation. It grows from the surf zone to depths of at least 8 m (26 feet), and is abundant in reefs several kilometers landward from the slope break where no outer barrier exists (p. 35, parenthesis mine).

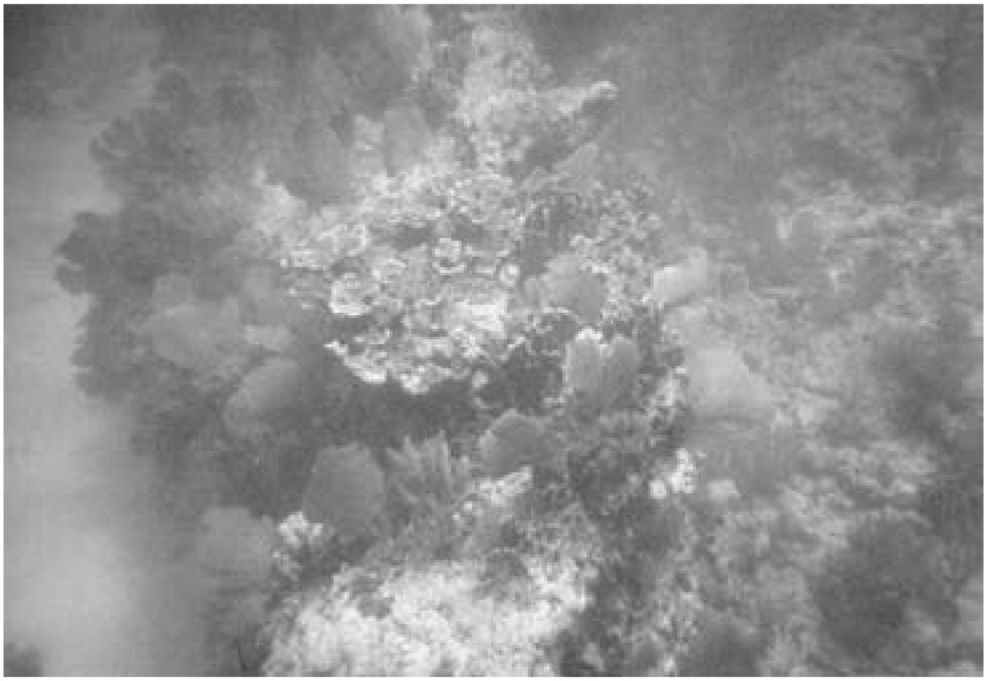
*Acropora* coral branches tend to grow together into thickets. According to Shinn (1977):

> Continued unidirectional growth causes individual colonies to coalesce into fingerlike spurs that project as much as 200 feet into oncoming seas. These "living spurs" die from crowding when they reach the surface... (p. 209).

The coral branches forming the spurs are more circular and massive in cross section com-



*above*: **Figure 2. The Western Sambo patch reef with a dive boat approximately 30-feet long on the right side of image. The dark spurs are composed of *Acropora* coral that approach the water surface. They are separated by the light-colored deep grooves. The shallow area behind the spur and groove structure is the reef flat.**



*right:* **Figure 3. A small crop of *Acropora palmata* coral is growing on top of a spur at Molasses Reef. Sea fans (predominately *Gorgonia ventalina*) dominate much of the spur surface.**

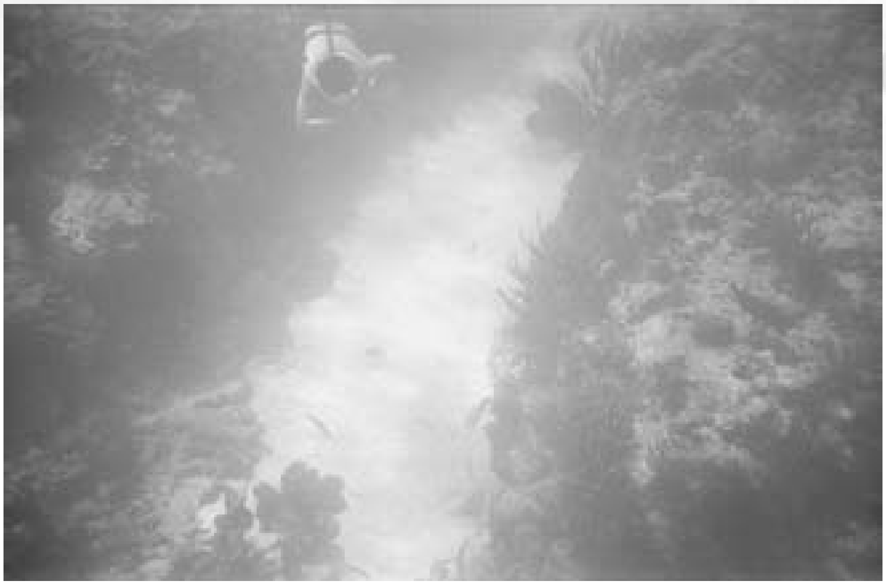


**Figure 4. Small spur and groove structure at Looe Key Reef. Note person at top of image for scale.**

pared to those growing in protected or calmer waters (Shinn, 1963). However, even in the more massive form, storm waves can still break apart the Elkhorn coral (i.e., *Acropora*) contributing to reef debris. If not flushed of the accumulating carbonate material, the grooves (Figure 4) can fill and extend the reef flat toward the open water, thereby limiting the space available for further spur development.

Spur and groove morphology is not limited to the Florida Coral Reef Tract. This reefal structure has been identified at many coral reefs around the world (Table 1).

## *Acropora palmata* Growth Rates

Under modern reef conditions, *Acropora palmata* can grow relatively quickly, as much as four inches per year (Shinn, Halley, and Hine, 2000). At this rate and with accommodation space provided by sea level changes, *Acropora* could grow 333.3 feet in as little as 1,000 years! This is approximately 200 feet more than the total thickness of the carbonate layer presently recognized as composing the Florida Keys Coral Reef Tract (see Froede, in press). Uniformitarian scientists assert that the Florida Keys (i.e., Pleistocene age coralline islands) and adjacent Holocene coral reef tract have been developing for the past 100,000 years (Hoffmeister, 1974). This disparity of the apparently missing coral has not been addressed by naturalists in defining the differences between the amount of coral found today across the Keys and the amount that should be present if tens-to-hundreds of thousands of years have been available for coral reef development (Froede, 1999).

## Paleozoic-Mesozoic Spur and Groove Morphology

Spur and groove morphology has also been proposed for a number of reefal mounds found in both the Paleozoic and Mesozoic Periods (e.g., Barthel, 1977; Wood and Oppenheimer, 2000). It is important to note that scleractinian corals (i.e., the hard, radiate kinds of corals that compose the modern coral reef) did not exist during this period of time in naturalist history. Whether the morphology operated in the same (or similar manner) in which this form operates today is completely interpretative. In fact, some argument could be made that these pre-scleractinian structures were not "reefs" at all but structures with features that suggest a similar morphology (Braithwaite, 1973).

## Discussion and Conclusions

Spur and groove morphology is best developed on the seaward side of an *Acropora* dominated patch reef as a function of wind and wave energy. Its widespread occurrence, not

**Table 1. Although not a comprehensive list of references dealing with the subject of spur and groove morphology, the cited articles provide information related to the development of this unique coral reef from around the globe.**

| Atlantic Ocean | Pacific Ocean | Indian Ocean | Red Sea | Caribbean |
|---|---|---|---|---|
| 1) Macintyre, 1988<br>2) Chiappone and Sullivan, 1996 | 1) Wolanski and Delesalle, 1995<br>2) Pandolfi, 1995 | 1) Gabrié and Montaggioni, 1982<br>2) Sheppard, 1981 | Sneh and Friedman, 1980 | 1) Roberts, Wilson, and Lugo-Fernández, 1992<br>2) Steiner, 1999 |

only across the Florida Keys but also worldwide, suggests that it does not develop by accident. Changing sea level position has served to create at least two tiers of spur and groove structure along portions of the Florida Keys. What appears to be missing is the physical evidence that supports 100,000 years of coral reef development.

The suggestion that spur and groove morphology is functionally equivalent for "prehistoric" reefs is completely subjective. Too many unknowns exist to accurately determine if the inferred structure operated in a similar manner with creatures that are now extinct.

The coordinated growth of separate stands of *Acropora palmata* form the spur and groove morphology exhibited along the Florida Keys Coral Reef Tract. How individual coral polyps could have evolved to communicate in a manner that directs their growth into this successful form has not been addressed by naturalists. The consistent development of this reef structure worldwide demonstrates intelligence in design and the preferred end state for maximizing the growth and development of healthy *Acropora*-dominated patch reefs.

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Carl R. Froede Jr.
2895 Emerson Lake Drive
Snellville, GA 30078-6644

## Devonian Fish and Tetrapods Support Creation—Not Evolution

The period of time on the evolutionary dating scale from 360 to 370 million years before present (my bp) is packed with fossil four-legged creatures called tetrapods, including such as *Ichthyostega*, *Acantheostega*, *Tulerpeton, and Hypnerpeton*. Because of this, there could have been no evolution of fish to tetrapods 360 to 370 my bp because tetrapods were "already" present.

Back at 370 my bp, two more tetrapod fossils are present—*Obruchevichys* and *Elginerpeton*. *Elginerpeton* is dated at 373 my bp, depending on the source. *Elginerpeton* specimens show signs of having been in the water, then coming out onto land for a time, and finally going back into the water (Brown, 1999 and Westenberg, 1999). To add to these, yet another tetrapod was present at that "time." The evolutionary origin of these tetrapods would have taken about 5 my and would go back to a "time" between 375 and 380 my bp, depending on the date of *Elginerpeton*. This time scenario does not include evolution from fish to tetrapod but involves only changes proposed within the tetrapods.

Panderichthyids are the fossil fish favored to have evolved into tetrapods. But the putative Panderichthyid fish ancestors made their first appearance in the fossil record only 378 my ago. This would have given only 5 my or less for fish to have evolved into tetrapods—an impossibly short time for the changes necessary to have occurred.

Furthermore, *Sinostega* is a tetrapod dated between 376.5 and 382.5 my bp. This indicates that the supposed fish ancestors of tetrapods (*Panderichthyids)*, would already have been surrounded by the *Sinostega* tetrapods, an impossible situation!

But even if *Sinostega* tetrapod fossils had not been discovered, the very short time between the tetrapod *Elginerpeton* and its supposed fish ancestors (*Panderichthyids)* would have ruled out evolution from fishes to tetrapods. Tetrapods occur from 360 my bp back to 380 my bp in the evolutionary dating scheme. Some of these tetrapods, as we have seen, occur "earlier" than their supposed ancestral fish, leaving the theory of evolution dead in the water.

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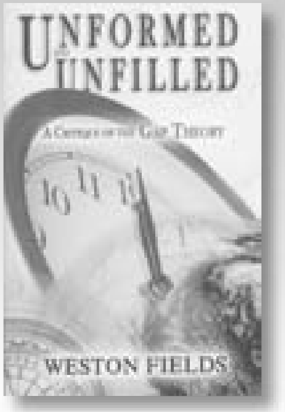
England, UK, WA3-3LE



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**Statement of Belief**—Members of the Creation Research Society, which include research scientists representing various fields of scientific inquiry, are committed to full belief in the Biblical record of creation and early history, and thus to a concept of dynamic special creation (as opposed to evolution) both of the universe and the earth with its complexity of living forms. We propose to re-evaluate science from this viewpoint, and since 1964 have published a quarterly of research articles in this field. All members of the Society subscribe to the following statement of belief:

1. The Bible is the written Word of God, and because it is inspired throughout, all its assertions are historically and scientifically true in all the original autographs. To the student of nature this means that the account of origins in Genesis is a factual presentation of simple historical truths.
2. All basic types of living things, including humans, were made by direct creative acts of God during the Creation Week described in Genesis. Whatever biological changes have occurred since Creation Week have accomplished only changes within the original created kinds.
3. The Great Flood described in Genesis, commonly referred to as the Noachian Flood, was a historical event worldwide in its extent and effect.
4. We are an organization of Christian men and women of science who accept Jesus Christ as our Lord and Savior. The act of the special creation of Adam and Eve as one man and woman and their subsequent fall into sin is the basis for our belief in the necessity of a Savior for all people. Therefore, salvation can come only through accepting Jesus Christ as our Savior.